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THE BATTLE OF NEW ORLEANS
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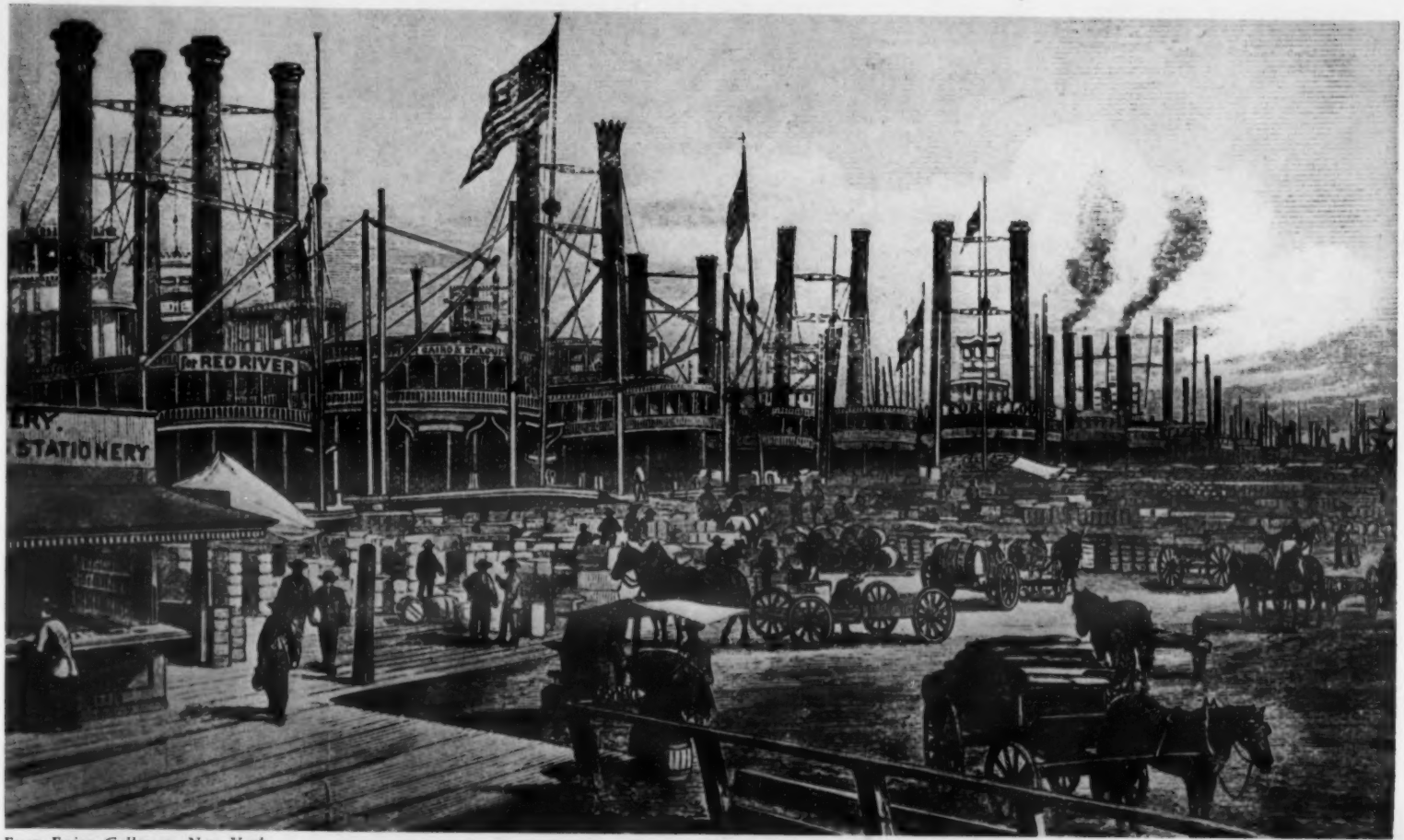
PATIO ROYALE

A typical old New Orleans courtyard—now a popular restaurant.

By Ewing Galloway, New York

THE ST. LOUIS CATHEDRAL
On the right is the statue of General Jackson.

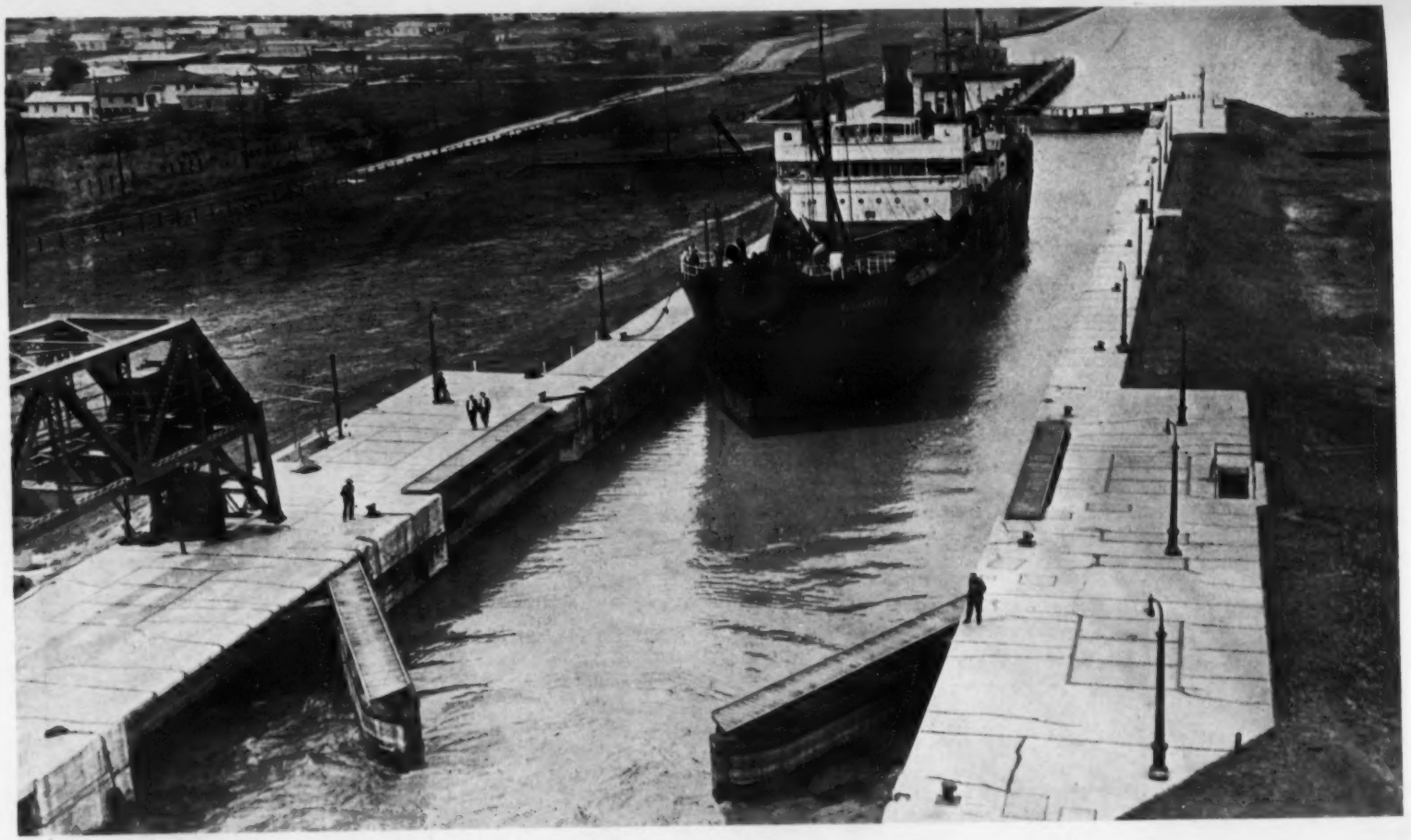


From Ewing Galloway, New York

NEW ORLEANS WATER FRONT, 1860

From Ewing Galloway, New York

NEW ORLEANS WATER FRONT, 1860



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BETWEEN LAKE PONTCHARTRAIN AND THE MISSISSIPPI

By Ewing Galloway, New York

THE CHALMETTE MONUMENT

Courtesy Naval Records and Library, Navy Department

COMMODORE DANIEL T. PATTERSON, U. S. NAVY

Commodore Patterson commanded the American naval forces before and at the Battle of New Orleans.

THE BATTLE OF NEW ORLEANS

N. P. Fitzpatrick, New York

Courtesy Naval Records and Library, Navy Department

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THE BATTLE OF NEW ORLEANS

BY THE HONORABLE ERNEST LEE JAHNCKE
ASSISTANT SECRETARY OF THE NAVY

EDITOR'S NOTE: Address delivered before the members of the Louisiana Historical Society and citizens of Louisiana on the anniversary of the Battle of New Orleans.

IT IS natural we all take satisfaction in projecting from the traces of the past the lines of the future, in order that we may derive from history its lessons and upon them lay our future courses.

Man may not know all, nor can he learn all that his fellows know. But he can, by utilizing the means at his command, collate his knowledge so that he can have from it the fullest picture with all the shadings and color of experience which is the essence of that record of human achievement which we call history.

Today is one dedicated to recall the memory of the splendid sacrifice, made upon our own soil, of those American soldiers, sailors, and marines of a century and more ago.

In talking of the naval factor which influenced development of the American strategy to bring victory to our arms at Chalmette, I am only taking from the record of that stirring period a few of the details which too many of our historians have neglected.

A fuller appreciation of the magnificent part played by our naval and marine officers in shaping and helping to win the Battle of New Orleans cannot dim the glorious valor and leadership of Andrew Jackson, nor can it lessen the tragedy which lay in the death of Pakenham, so fresh from his peninsular campaigns.

Too many of our people, serene in a consciousness of America's greatness, are apt to forget the storms that attended its birth and early years and to overlook the capacity of their forbears to endure hardship, privation, and danger for the sake of free institutions. In reverence of what we have become, too often we overlook the environment of our beginnings.

We have become what we are—what, please God, we shall be always—largely through the loyalty, the valor, and the capacity and patriotism of those who led the struggles for freedom and justice upon the sanctified soil of Chalmette and other hallowed fields. If we allow such sacrifice and service to be forgotten we will not be able to reap, nor to preserve for posterity, the fruits of their victory.

We are essentially little different from our great-grandfathers. It was an army of citizens under the leadership of Andrew Jackson that turned back Britain's seasoned veterans in the Battle of New Orleans and defeated a formidable invading force. Around nucleuses of small regular military and naval forces the young Republic raised its armies and its navies to meet its emergencies. The same policy persists today.

The United States does not saddle its people with an unreasonable tax burden but maintains sturdy peace-time forces which are the backbone of the potential fighting strengths of which we may have need. Our policy of national defense has developed from the early days when a sturdy citizenry

gave us our strength. Today we do not depend upon the professional soldier and sailor but upon the citizen whose foresight has allowed, through Congress, a national defense built around a good Army and a good Navy, each of which has definite peace-time functions. Should occasion arise when men or nations cannot be disposed through moral impulse to respect the rights of free people, physical force must stand against aggression and imposition. In the scheme of our civilization the soldier and the sailor are one and the same, being different only in the element upon which he depends for his activities.

In paying tribute to those heroic soldiers and sailors of 1814-15 we come again to an appreciation of the citizen and to a realization of our responsibility to those small forces of regulars whom we maintain ashore and afloat as the keyed units of our national defense. The great George Washington told us that "when we assumed the soldier we did not lay aside the citizen," while Blackstone, drew for us our own likeness, saying that "it is because he is a citizen and would wish to continue so, that he makes himself for awhile a soldier."

We, today, have the same duty to our homes and institutions as that of our forbears in 1814. Though we have no foreign foe threatening at our doors, we are not relieved of the responsibility to make for our children their greatest opportunity in a free atmosphere. For posterity, as well as for our own offspring, there is our continual need of pointing to youth the valiant and patriotic example of those sturdy builders who have given to us our country and its institutions. Under the influence of racial elements unsympathetic with the American ideal there is a danger of breakdown of the structure erected by our forefathers, unless we are vigilant, loyal, and alert in the preservation of the rational and emotional ties that we have with our past. Our schools should continually instill the principles upon which the United States rests. There is no need for apprehension if these principles and ideals are indoctrinated in the minds of American children during their formative years.

New Orleans is one of the great seaports of the world. New Orleans is the gateway to an empire which was a pawn in the games played by the great kingmakers upon the checkerboard of the world. Europe lost a pawn when the astute diplomacy of Ada and Jefferson, supporting our plenipote tiaries in Napoleon's court, tempted the L tle Corporal to reacquire the Louisiana Te ritory from Spain by the secret treaty San Ildefonso, after which he yielded to and Jefferson bought this great domain valley and delta, paying Napoleon in bi drawn on a Dutch-English banking hou The imperial valley of the Mississippi w the prize at stake in three wars: The Fren and Indian, the Revolution's unsung epic the western borders, and the War of 181 In 1803 Jefferson consummated the Louis ana Purchase. A distrustful people s Laussat reacquire Louisiana for Fra only to deliver the territory to the comm sioners, Claiborne and Wilkinson.

How the territory, though American decree and by law, remained European spirit and in attitude was well described the reports of Captain John Shaw of t American Navy, written while he was duty at our first naval station on the Tch functa near Lake Pontchartrain.

It was the common sacrifice of Jackso volunteers and the Louisiana militia, welde by a common danger into the Army of t Defense of New Orleans, which perfect the title of the United States to Louisian and sealed in blood the bond that bin Louisiana to the United States.

New Orleans and Louisana do not alo realize their importance to the United State They take a place in national and wor affairs second to no other. New Orlean smiles a friendly welcome across the Gul of Mexico and the West Indies, and sees b yond the Caribbean the front doors o friendly republics. She is around Panama close corner from the Orient and can b neighborly at once with Europe and Africa South America, Asia, and the Antipode and all the countries that border the Seve Seas. She is a crossroads of the world.

Here is a natural gateway to one of th richest, most populous, and diversified re gions of the earth, the storehouse of muc of our natural wealth. President Hoover- when he spoke at Louisville—visualized th opening of great inland waterways, fro the Gulf of Mexico to the far broad field of the valley's fertile sweep. Later, it wa my great privilege to have from him a mes sage of confidence in the present and in the future of New Orleans. The substance o

that message, my fellow Louisianians was, "Do not sell New Orleans short." This is the inheritance you have from the makers of our nation.

It is to preserve this that we have our modern system of national defense in which our peace-time Navy plays such an important part. Andrew Jackson, whose memory we honor, outlined what we know to be a reasonable concept, saying of the Navy that "it is your true policy, for your Navy will not only protect your rich and flourishing commerce in distant seas, but will enable you to reach and annoy the enemy, and will give to defense its greatest efficiency by meeting the danger at a distance from home". Andrew Jackson, in his completion of the Mobile campaign and in his eventful defeat of Pakenham before New Orleans, had reason to know of the importance of naval operations.

To us who share a reverence for glorious tradition as we bow before the soft color of romance, New Orleans holds an inspiration which we pass to our guests and visitors so that they can see New Orleans as a multiple shrine of history. The very cobblestones of the streets have a story to tell. What a pageant of greatness is that procession of historic notables from the day the Sieur de Bienville, in 1718, laid claim in fact to this spot in the name of Louis Philippe. Each phase of her history is a part of the romance of Louisiana.

We celebrate tonight the one hundred and sixteenth anniversary of the Battle of New Orleans, fought on the field of Chalmette where earlier in the day the herioc deeds of Jackson's men were memorialized. To understand it wholly one must understand the broad part played by American naval forces, not only in the fighting of the series of engagements which culminated in the battle, but in the development of the major strategy by which the invading forces were successfully combated. In importance in American history, the Battle of New Orleans ranks only after Saratoga where Burgoyne surrendered, and after Yorktown where Cornwallis's capitulation marked the success of the war for independence. Have you wondered that the Battle of New Orleans, having been fought after the Treaty of Ghent, was really important?

The American forces not only drove back the invader at Chalmette but their valor sealed for all time the peace treaty with England. The United States had won treaty concessions and a favorable peace agreement from Great Britain at a time when Napoleon's star had not set, when the Little Corporal was still the greatest force in Europe. True, Europe had harried the Emperor so successfully that Pakenham's forces, released from the peninsular operations, were available to prosecute the war in the west. While they were forming, other factors so strengthened American claims that our treaty delegates were sought by Britain and a splendid peace arranged.

But strategists of all nations, master tacticians of the world, are agreed that had not the Battle of New Orleans been fought and won by American arms, the War of 1812 would have developed a new phase and we would have again been menaced from abroad. History's verdict is unanimous that it is well that the news of the treaty failed to reach New Orleans before January 8, 1815.

Jackson's victory at Chalmette rounded out the American growth and perfected the acquisition of Louisiana. A review of the elements of all that great achievement provides illuminating study. In them, one finds fresh basis for faith in our institutions and keys for the solution of many modern perplexities. It must not be understood that, in stressing the importance of naval factors in shaping the final campaign of the War of 1812, I imply that the services of the sailors and marines have not been recognized. A few years ago in old St. Louis Cemetry number one, where so many of our illustrious dead sleep in eternal rest, we gathered to dedicate a tablet at the grave of Major Daniel Carmick, an American marine officer, who was mortally wounded in the engagement of December 28 preceding the Battle of New Orleans. Congressional recognition was given this valiant officer for his service in defense of this city and it is true evidence that New Orleans does not forget that the memorial tablet was fixed to further mark his tomb.

But how many here know that four months and six days before that glorious achievement Commander Daniel Todd Patterson of the American Navy, then stationed here, persuaded Jackson, then at Mobile, that the true destination of the British expedition then assembling at Jamaica was New Or-

leans? That Patterson insisted that Jackson repair here with his available forces for our proper defense? Jackson had asked Patterson to bring his light vessels to Mobile. No uncertainty then pervaded Patterson's mind. The British destination was not Mobile—it was New Orleans. Patterson's information, strange though it may seem, came from none other than Jean Lafitte, the Baratarian pirate. The British had tried, unsuccessfully, to enlist Lafitte in their cause. He cast his fortunes with the imperiled resident Americans. Those fifty British naval vessels with 10,000 land troops were preparing to strike at this economic outlet of the Mississippi.

And let me ask a further question—who knows that fifty-one days before Jackson's final battle, Patterson foretold what the British would do in these waters and on this soil, even predicting Chalmette as the exact locality where the final battle would be won?

The splendid achievements of the American Navy, more especially those in the six weeks prior to Jackson's victory, have never been sufficiently emphasized. Just as little Belgium in the recent World War spent herself in holding back the Germans while England and France assembled their armies prepared for the defense of French soil, so did Patterson sacrifice his ships and his men in delaying the British advance over Lake Borgne and its adjacent waters, giving to Jackson that precious time that enabled him to organize his slender forces in such dispositions as to resist the invaders effectively.

The heroism of Belgium in her self-immolation has been widely acclaimed, but not so the like sacrifices of our infant Navy in these waters. That is a field of study the historian has overlooked. Ask any eighth grade schoolboy who won the Battle of January 8, 1815; will he mention the important part the Navy there played? But Patterson was the one who forced the final issue to the exact spot where Jackson fought the British. The invading force of the British, in ships and men to the number stated, left Negril Bay, Jamaica, November 26, 1814.

The army that burned our national capitol the preceding September formed part of that force. It included also 4,000 troops from Plymouth, England, commanded by a General Keane, a gallant young Irish officer. These invaders reached the Chandeleur Islands, December 9. Their passage was marked by music, dancing, theatrical performances, and other hilarity. The wives of many officers accompanied the expedition. All felt confident an easy victory awaited them. All were filled with the delightful anticipations this New World seemed to offer them. They presumed the Americans profoundly ignorant of their approach. In confidence the British fleet and transports containing the army of invasion anchored in the deep waters between Ship and Cat Island near the entrance to Lake Borgne. They prepared at once their small vessels for the transportation of their troops. They had to cross the adjacent shallow waters to their intended landing place.

But the revelations of Lafitte and the vigilance of Patterson had created quite a different situation from that which the British anticipated. Five gunboats, a tender, and a dispatch boat were awaiting in the passes of Mariana and Christian. Lieutenant Thomas ap Catesby Jones, their commander, had dispatched previously two other gunboats to Dauphin Island, at the entrance of Mobile Bay, to report intelligence of the foe. These vessels discovered the British fleet on December 10. Their reports reached Patterson. Jones was then directed to take such positions as would enable him, once the British in their light vessels attempted to enter Lake Borgne, to oppose their advance and at all cost prevent their landing. Jones's ships made for Pass Christian. There the enemy discovered him December 13. Admiral Cochrane, commanding the British expedition, immediately changed his plans. No attempt was to be made to transport troops while these American gunboats were afloat. All effort was to be concentrated to destroy them.

Theodore Roosevelt, as the historian, wrote concerning this situation: "It was impossible for the British to transport their troops across Lake Borgne as contemplated until this flotilla was destroyed." On December 14, the British advanced to cross the lake. Jones, with his five small gunboats in line between Point Claire and Malheureux Island, fought the British, as they advanced in forty-two barges with 1,200 men. In that encounter he lost, as was expected, his entire flotilla. Of Jones' force of seven officers and two hundred and four men, six were killed and the thirty-five wounded included Jones, the commander. But he accomplished

his mission. The British were delayed with a loss of about three hundred killed and wounded including their commander, Lockyer, wounded.

At length, by December 20, the British troops were landed on Pea Island at the mouth of Pearl River where General Keane took command to organize the vanguard for future operations. From disaffected former Spanish residents of New Orleans, the enemy was informed of the feasible route of advance to the city, via Bayous Vienvenue and Mazant and the canal across Villiere's plantation. Over this route the invader came and on December 23 we find him established with one-half of his army at a point one-half mile from the Mississippi banks and nine miles below New Orleans.

The British from there sent out posters to the inhabitants in Spanish and in French: "Louisianians: remain quietly at your homes; we make war only against Americans."

The enemy was in fine spirits. Not a gun had been fired since Jones' flotilla had been destroyed. Here at seven o'clock that evening, December 23, they met new difficulties from the Navy. The guns of the *Carolina* and the *Louisiana,* then on the Mississippi and under Patterson's command, drove them from one position to another. For three days there was not an hour that Patterson failed to sweep the British field. The invaders then concentrated their entire force of artillery on the *Louisiana* and *Carolina.* On the twenty-seventh the destruction of the *Carolina* was accomplished—with an American loss of three killed and nine wounded. The *Louisiana,* however, from the opposite bank of the river continued to annoy them. And the guns of the *Carolina* were promptly put ashore, manned by her surviving sailors, to augment Jackson's command, being posted in front of Jourdain's plantation in a position commanding the enemy's left flank.

Time does not permit me further to describe the conflicts that followed almost daily until the final battle of January 8.

Major Carmick of the marines bore a prominent part in many of these, his command consisting of De Bellevue's marines, Plauche's and Daquin's battalions, McRea's artillery and two hundred "men of color" from Haiti. On December 28 he fell seriously wounded. These were briefly the conditions that forced the British to delay their final attack until January 8, 1815, thirty or more days of respite precious to the Americans.

The losses of the Navy both in ships and in men were the price gladly paid to give Jackson time to augment his meager force and arrange them for effective defense. His main line was established along an abandoned canal on Chalmette plantation about five miles below the city, a line extending from the river to an impassible swamp a mile to the northeast. A flanking position was also prepared on the opposite (right) bank of the Mississippi. Jackson's position was one of great strength; it could be attacked only from the front; it, as a site for defense Patterson had prophesied as "a narrow strip of land . . . through which an army cannot march, nor transport artillery."

Here the British lost, on that memorable day we commemorate, no less than 2,600 men, of whom 700 were killed, 1,400 wounded, and 500 taken prisoner. This included Sir Edward Packenham, the British commander, killed in battle. The American loss was but eight killed and thirteen wounded. Thus the Battle of New Orleans with a tremendous British loss passed into the records of American history.

Patterson's gallant and efficient subordinates of the Navy were afforded their meed of praise, for he wrote that General Jackson freely acknowledged that the "unwearied exertions of the small naval force on this station, from the first appearance of the enemy has contributed in a great degree to his expulsion."

Nor did Congress overlook the Navy. In its resolution, it stated that the Congress entertained "a high sense of the valor and good conduct of Commodore Daniel T. Patterson, of the officers, petty officers, and seamen attached to his command, for their prompt and efficient coöperation with General Jackson, in the late gallant and successful defense of the City of New Orleans."

I do not share the view that republics are ungrateful. But, my friends, they are forgetful. Strive as we may by international understanding to insure the maintenance of peace, war may come to subsequent generations. In that event, pray though we may that ours may be spared, Americans must win if they face the necessity of making war. The will to win lies in the spirit of

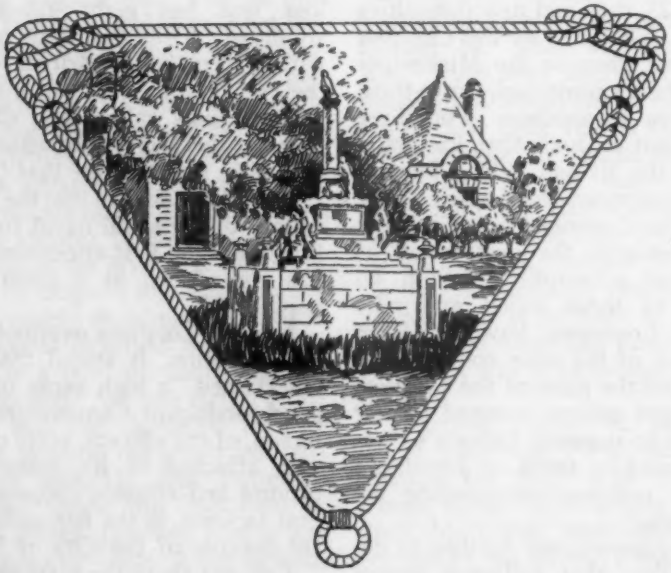
those who are called to fight; if their tradition is bright and their cause is just they must have the capacity to appreciate those advantages.

For the safety of future generations, you must in peace preach the glories of constructive endeavor as you instill into the hearts of all Americans an assurance of right that needs only a threat of danger to arouse them to the defense of our free institutions. What better text for each lesson than the pages of our glorious history; the lesson of secure peace and the lesson of war for right.

Let us nurture the stamina, the courage, and the patriotism that is our heritage from our forbears so that posterity may have American ideals and American idealism. We truly find a guarantee of our country's future in a proper pride in its glorious past.

The American flag, the Stars and Stripes, supplanted here the banners of Spain and of France. It, as the emblem of our liberty, resisted successfully on this soil a formidable British invader advancing proudly and gaily, confident of victory, under the Cross of St. Andrew and the Cross of St. George. It is a proud flag, my fellow-citizens, an emblem of freedom and of justice. I call upon you—stand true! Look along the straight avenues of our history and see the light of honor, the badge of courage, the brilliant rainbow of a pure ideal.

Out of our history lift the spirit of our future, a single essence that is the heart and soul of America, and hold it secure for posterity.



A STUDY OF THE INTERNATIONAL PETROLEUM SITUATION

By Lieutenant J. H. Skillman (S.C.), U. S. Navy

I

THE international aspects of the petroleum industry are not analogous to those of other major industries whose interests in foreign affairs are confined to the development or expansion of their markets or the assurance of a source of supply of raw materials. Rather, it is a combination of these, further augmented by the desire on the part of the so-called leading powers for control of a product necessary for the conduct of war, or modernistically speaking, the prevention of war.

As a nation we have exploited our oil resources with reckless abandon, not only producing for our own needs, but supplying other nations as well. In the meantime we have permitted foreign interests to gain an exceptionally strong foothold in our petroleum fields. These unfortunate situations may be due, in part, to the rapidity with which the oil industry enveloped the world's economic structure, more especially that of the United States. Two decades ago this industry was in its infancy—today it is a dominant factor in many phases of the struggle for commercial and political supremacy. From a political and military point of view, petroleum has played an important part in the numerous conferences that were an aftermath of the great war. Add to these existing conditions the uncertainty as to the world's supply of crude petroleum and the increasing use of machinery, and the situation becomes even more complex.

Within recent years several writers have stressed the importance of petroleum in the numerous attempts among nations to arrive at some sort of an adjustment in Europe and Asia subsequent to the Armistice in November, 1918. However, it would appear debatable whether this competitive condition is national or commercial as between nations. At any rate, it is not the purpose of this paper to deal with political intrigue and bargaining among nations. Certainly, the American participation in the world's petroleum market has been almost entirely a commercial one. While the same may not be true of some of the foreign powers, we may at least grant that the capital investments, with minor exceptions, were made by private interests.

Since it is a striking coincidence that the greater portion of the known petroleum resources, exclusive of the United States, are in territories at present more or less subject to foreign surveillance, it appears that the proper approach to the discussion of the international aspects of the industry would include, first, a brief outline of the attitudes or policies of the major powers in their attempts to become dominant factors in the petroleum fields, and second, a more comprehensive survey of the known oil resources, the political situation in the countries where these resources are located, and their present and potential development.

A brief survey of this phase of the subject requires the inclusion of certain historical data, since events such as the great war have played a huge part in the whole international development. Inasmuch as the national interests in the world's supply of crude petroleum are vested almost entirely in the United States, Great Britain, France, and Japan, from the point of view of national defense and commercial independence, this brief survey may be confined to these four countries. Germany's decline following the cessation of hostilities, and Italy's relative unimportance (some may question this statement) both from a commercial and military standpoint, precludes them from further consideration, although German interests had made considerable inroads in the Russian fields prior to 1914.

II

In the United States the problems of overproduction and depletion of the known oil deposits have occasioned a great deal of public comment, but little of a constructive nature has been accomplished. It must be remembered that every so-called acute shortage has been accompanied by the discovery of rich petroleum deposits in other localities somewhat adjacent to the former fields, or in the same localities by deeper drilling. Therefore it is logical to assume that the present published estimates of our oil resources are no more accurate than those published during the initial stages of the industry. The same uncertainty applies to foreign deposits as well. The recent events, arising out of the Teapot Dome and Elk Hill investigations are common knowledge and need not be discussed here, but it is not improbable that these unfortunate occurrences may ultimately lead to an intelligent and wholly necessary plan of conservation.

In the development of the industry within our boundaries, the Standard Oil Company has played a leading part. This company has, in addition, evinced great interest in the oil resources of Mexico, Russia, Mesopotamia, and certain minor states of Central and South America, efforts to establish itself in these fields at times assuming the aspects of a national struggle. It must be admitted that until recently the Standard Oil has lacked the diplomatic assistance that was of such benefit to its competitors, the Royal Dutch-Shell, Mexican Eagle, Anglo-Persian Oil, and British Controlled Oilfields. At the same time, Standard Oil and others were forced to meet competition from the British interests in our own field and our domestic markets, mainly through the aggressive efforts of the Royal Dutch-Shell. During this time the United States government assumed a passive attitude, although the "Leasing Law" of 1920 empowered the state to refuse concessions to the subjects of countries which did not grant reciprocal facilities to subjects of the United States. But, with one exception in 1921 when a single large company was denied a concession, no use seems to have been made of this law. Meanwhile the imports of oil, mainly from Mexico, have been more than counterbalanced by oil exports, for the most part to Europe. To say the least, a very generous policy and, from the point of view of national defense a very unwise one.

Great Britain's sphere of interest in the petroleum industry, unlike the commercial interests of the United States, became one of aggressive conquest when it was realized that the successful operation of the fleet and the continuation of England's strength at sea depended upon the use of oil in all fighting ships. As in other phases of their economic life, the British were slow in divorcing the old order, but once adopted, a new policy was always an aggressive one. With the exception of the activities of the Royal Dutch-Shell in the United States, the British interests have been confined almost entirely to Mexico, southern Persia, Mesopotamia, and Russia. Just before the great war broke out the British and American oil interests fought their first serious battle in Mexico. Apparently the American magnates had witnessed with increasing annoyance the numerous advantages conferred upon British petroleum interests, especially the Royal Dutch-Shell, and the subsequent disorders in Mexico may have been due, in a large part, to the bitter struggle between these two oil interests. At no time have the British companies recognized what they considered the confiscatory policy of the Mexican government, but they have adopted the policy of subsidiary companies, a half-hearted attempt to gain more favorable treatment.

For over a century Great Britain has exercised a sort of protectorate over the littoral of the Persian Gulf. It was a natural move that this protectorate should lead to the development of the rich oil fields in the hinterland, and at this juncture the British government came to the assistance of the Anglo-Persian Company by purchasing some ten millions of dollars of the otherwise unsalable shares. Besides increasing the capital of Anglo-Persian again and again since its formation in 1909, the company has founded numerous subsidiaries. The aims and fields of action of these subsidiaries differ substantially, but one common characteristic of all of them is the express stipulation that British capital shall always predominate. One of these companies, the Bachtiari Oil Company, has as its sole object the initial stages of development and production of the more remote

and inaccessible fields in the southern interior Persian oil districts, and to insure peaceful development of these undertakings allots 3 per cent of the shares to the various warlike Bachtiari chieftains in the district. In 1915, as a final factor in the development of these fields, the British Tanker Company Limited, was formed, and in 1917 the company was further enlarged by a great number of additional tankers.

The British participation in Mesopotamia grew out of certain mandates administered by the various powers in the name of the League of Nations, in the final distribution of which Great Britain received the mandate for Mesopotamia and Palestine. Since France received the mandate for Syria, the question of boundaries became an important one, and there followed several years of diplomatic controversies which came to an end in actual warfare between Greece and Turkey. Meanwhile France and England could not agree. The importance of this effort to gain control of these important deposits finally came to a climax in the formation of the Turkish Petroleum Company in March, 1926, of which more will be said elsewhere in this paper. One might dwell upon this Mesopotamian struggle at some length, because it is typical of the whole political and economic warfare for the control of petroleum.

The entry of the Bolsheviki into Baku in February, 1921, marked the end of a seven years' struggle on the part of Turkey, Germany, and England to acquire the Caucasus, Baku in particular. At present Baku and Grosni are producing under Russian management, but Emba, a large and potentially rich field, is open for exploitation. The topographical disadvantages attached to this region may be too great to warrant British negotiations; but it is apparent that any signs of a stabilized and receptive government in Russia will find England bidding for a considerable portion of the oil concessions. These activities of Great Britain are illustrative of the extent to which a nation, poor in natural resources, will go toward assuring an adequate supply of such materials necessary for national defense and commercial development.

In the competitive field of the world's petroleum supply, France plays a modest and passive part, even though its colonies, and finally France itself, have oil deposits of great potentialities. Algeria, Madagascar, and other French possessions are being explored and even worked by British companies. The French attitude in Mesopotamia was not one of such disinterestedness, and was the lone exception.

The traditional oil policy of the French has been governed solely by the great French banks—not one cent for exploitation, and great sums for investment in foreign oil companies. The result has been the accumulation of great wealth without the responsibilities of control and operation of major petroleum holdings. In the main the French petroleum trade is a monopoly acquired by ten concerns in the form of a cartel. The success of this combine was aided by a favorable tariff which allowed an unusual classification of crude oil, reduced the need for refineries to a minimum, and at the same time kept out foreign competition. Meanwhile this same tariff law reacted against the importation of crude oil residue, a necessary fuel for industrial purposes, and for this reason France suffered undue hardships during the World War: This law was modified somewhat in August, 1919, permitting the importation of crude oil more economically.

Of all the nations to be considered in the light of their policies as regards the world's oil supply, the position of Japan is the least known. We do know that Japan has insufficient oil reserves for its naval and industrial needs and must turn elsewhere for the greater portion of supply. The political situation in the Orient is too unsettled to make other than a hazardous guess as to the outcome, but China and Russia, and more especially the island of Sakhalien (sometimes spelled Saghalien) undoubtedly offer future possibilities as a source of oil for Japan. However, a survey of this particular situation would lead to a discussion of conditions outside the scope of this paper. But the petroleum situation in the Far East depends, to a great extent, on concessions granted by the Soviet government for the exploitation of the rich fields in Sakhalien. Japan, with her extreme need for oil, may be expected to exert more effort towards control of fields in the Far East than will commercial interests of the United States or Great Britain under existing unfavorable conditions.

The unsettled conditions in China, and

Japan's inability to meet with favorable regard on the part of China, led to the closing down of Japanese oil companies in the provinces of Shensi and Chili. Meanwhile the petroleum extracted in Japan proper has been steadily declining since 1915, the production in 1925 amounting to only 266,000 tons.

In July, 1920, Japanese troops occupied Northern Sakhalien. About this time the Soviet government leased the upper part of the island to an American company (Sinclair's), and during this time the Royal Dutch-Shell had a claim to these fields. In 1921 the United States government protested to the Japanese that no recognition could be made of claims arising out of present occupation or control of Northern Sakhalien. The grant to the United States company was conditional upon our recognition of the Soviet government within five years. The ultimate failure of this company in this undertaking is not due, entirely, to conditions in the Orient. Public sentiment and a decline in political prestige plays an important part in American business.

III

Petroleum occupies a paradoxical position among minerals in that new researches and developments tend to increase rather than decrease the possibilities of discovery. For this reason present estimates of explored fields are, at best, only a matter of speculation. In addition to the explored fields there are certain localities in China and Australia where oil is believed to exist in large quantities, but the territories are too undeveloped to estimate the productive possibilities.

Other localities such as Canada, Egypt, and certain parts of India, are known to contain oil, but in comparatively insignificant quantities. The East Indies are productive and are being exploited by the British. We know little of the continent of Africa other than Egypt and a portion of Algeria. The deposits in Central Europe are confined mostly to Rumania, Germany, and France. Rumanian oil fields are showing a gradual decline. In England and Scotland a considerable quantity of oil has been produced from shale. This method of production has been carried on for a period of seventy-five years and has been fairly profitable. With this brief survey we may turn to the more productive areas of Mexico, Russia, Mesopotamia, and Central and South America.

In Mexico the struggle for oil, mainly from a political viewpoint, has been carried on under conditions differing widely from those in the Near East. The first really important wells were opened in 1910, and by 1912-13 the British and American interests were on the field in earnest. Charges and countercharges were made that these companies were taking an active part in Mexican politics. Suffice to say that following President Diaz's reign ending in 1911, the presidential office changed with great rapidity. Madero, Huerta, Carranza, followed each other in rapid succession. However, the strongly antiforeign oil-concession laws enacted by Carranza, who was, obviously, pro-German, did a great deal to reconcile the British and American interests, for a time resulting in direct coöperation of these interests. Carranza laid down the principle that foreign purchasers of land could obtain ownership of its surface only, while all natural wealth below the surface belonged to the citizens of the country. Carranza also gave Mexico its first real constitution in 1917. Paragraph 27 of this constitution has become one of the most controversial paragraphs in the legislation of the New World. One provision of this paragraph prohibited foreigners from acquiring concessions within fifty kilometers of the coast, the better wells being within this district, and, finally, all concessions acquired after 1870 were subject to revision, which meant, in most cases, cancellation. In 1920 Obregon succeeded Carranza and the oil companies with hopes of more favorable legislation were doomed to disappointment, for Obregon not only upheld the concession law but raised the export duty on oil an additional 60 per cent. But the economic demand for petroleum was far greater than political barriers and the production of Mexican petroleum increased rapidly, reaching an output of nearly 200,000,000 barrels in 1920. Since that time the decline in production has been very noticeable. Such decline may be traced to the exhaustion of many of the large wells, and the restriction of operation to old territory owing to the uncertainties surrounding the acquirement and development of new areas. In 1925 a new petroleum law was passed

which differed little from the older laws, but recently through the efforts of Ambassador Morrow more favorable consideration has been given to our interests in Mexico. These considerations may be summed up briefly as taken from regulations signed by President Calles in March, 1928, and include:

(a) Rights held by foreigners in Mexican oil properties prior to adoption of Mexican constitution in 1917 will be confirmed.

(b) Rights will be validated in perpetuity supplanting confiscatory fifty-year confirmatory titles.

(c) Nature of the "rights" possessed by United States holders of Mexican lands in 1917 shall include "oil rights" only in case it can be proved that they performed some "positive act" showing that they were developing or proposed to develop their lands to produce oil.

During the first week of April, 1928, the United States Department of State warned American petroleum interests that they must abide by these decisions or expect no further diplomatic action. In a press dispatch of April 18, 1928, it was stated that practically every important oil company had accepted the new regulations.

It may not be amiss to state here that the Mexican people are developing an appreciation of the economic value of their oil resources, and further exploitation of Mexican fields would seem to depend upon the diplomatic foresight and ingenuity back of the capital interests.

At present, American interests control 70 per cent of the capital invested in Mexico, the British 27 per cent, and Mexicans 3 per cent. Perhaps the British occupy a decidedly safer and stronger position than do the American companies due to their more friendly relations with the Mexican authorities. At least, this seems to have been the case prior to the above-mentioned developments.

Although Mexico was the second largest producer up to 1927, that year saw Russia move into second place because of the effect of governmental interference on production in the former country. Apart from the usual political disturbance and the resulting stagnation in production, some of the best wells have ceased to produce and yield only a stream of salt water. Whether these are isolated cases or are forerunners of what may be the general results is one of the big problems of the Mexican producer.

The best proof of the importance of Russian petroleum is the efforts of the various powers and oil companies to get control. Geologists state there is more oil in the Caucasus than in Mexico, and more than in Turkey and Persia combined. Of all the Russian fields those centering around Baku on the shores of the Caspian, and the fields of the island of Sakhalien, have been the most desired by the various powers. Germany and Turkey undertook certain developments around Baku before the war but lost them in the general adjustment afterwards.

Before the establishment of the Soviet government the Standard Oil of New Jersey bought a half interest in the Nobel Oil Concern, the oldest of the Russian companies. Suffice to say the Standard Oil and Nobel interests lost their holdings, although the Standard Oil still has hopes of regaining the whole or part of its possessions. In 1912, the Royal Dutch-Shell expanded its holdings in Russia by the purchase of two companies that had been financed by the Rothschilds. These possessions centered mainly around Maikop and Grosni where rich wells were discovered. The productivity of these wells declined rapidly. Internationally, the position of the Russian oil industry is weakened by the fact that it is not subject to the direct control of a single company as is the case in American and Western European countries.

Events in Russia following the victory of the Allies were spectacular—the chaos accompanying the Bolshevik revolution offered an opportunity for the various powers to seize the oil fields by force of arms. But the unexpected strength of the Soviet government made such military adventures inexpedient. The spectacular has been eliminated but the competitive situation still exists.

On the whole the competition in Russia has been centered around the Standard Oil and its subsidiaries and the Royal Dutch-Shell. In this connection, the Soviets have never recognized Standard Oil's claim to property in Baku representing some fifty millions of dollars. Standard Oil purchased a half interest in Nobel's holdings and Nobel was a naturalized citizen of Russia. Consequently, when the Russian state na-

tionalized his property it ceased to belong to him, and he was in no position to sell it. A rather roundabout but nevertheless effective method.

In 1923 the Sinclair interests threw consternation into the ranks of these two factions when negotiations with the Soviet government appeared favorable. That the plan did not materialize was no fault of the Soviet régime. Meanwhile government operations were improving in Baku and Grosni and the chances for large foreign concessions seemed remote. But the same policy does not apply to Emba, since this particular field lies in a desert devoid of railroad connections and pipe-line facilities. For this reason Emba is on the market.

In 1925 the Soviets adopted a policy of granting minor concessions. To date two such concessions have been granted—one to an Italian-Belgian concern to explore for oil in southern Siberian steppes, and the other to a Norwegian corporation to explore and drill for oil in the peninsula of Busachi. In August, 1925, the Soviet government listed certain territories which are open to negotiations for concessions. These include Cheleken, Naptha Gora, Daghestan, Kertch Peninsula, Kakhetia in Georgia, Uchta, and Izbekstan. However, the chief producing centers of Baku, Grosni, and Maikop will be retained by the government. State operation has proved advantageous.

It appears to many students of international problems that the relations of China, Japan, and Russia are so interrelated that one may not be considered without the others. For example, Yusuke Tsurumi, leader in the Seiyukai Liberal Party of Japan, stated in 1924 that "Japan's vital issue in foreign affairs is China. Japan's Russian policy is important in the degree that Russia affects China." Of course many of these students are influenced by the much discussed "Far Eastern Triple Alliance" between Soviet Russia, Japan, and China. But here one runs into difficulties, the situation being less understandable when it is considered that Russia offered Northern Sakhalien to the Sinclair interests after Japan had openly expressed a desire for the concession. But eventually Japan did get the concession, resulting in the necessity of changing her entire transport structure. Since that time her imports from the United States and Great Britain show a noticeable decline.

Estimates show that the unleased oil on Sakhalien equals that already leased to the Japanese. The problem is, what disposition will the Soviets make of it? Here would seem to lie the gateway to further international complications in the Orient. To sum up the Soviet situation it would appear that the governing element in the Russian oil policy toward concessions to foreign interests depends entirely upon the prosperity of the country. In 1922 when the country was in a state of civil war and possible famine the Soviets were ready to conclude almost any bargain. Now with a greatly improved economic condition, a more independent attitude is noticeable.

The policy in Mesopotamia has been a British policy, almost entirely. At least this was the case prior to 1926 when the British concluded an agreement with the Americans and French whereby the Turkish Petroleum Company was reconstructed and the American interests were granted a 25 per cent participation in Mesopotamia. This agreement provided for an increase in capitalization to a thousand million pounds, to be alloted in four equal parts to the Anglo-Persian Oil Company, Royal Dutch-Shell, seven American companies (mostly Standard Oil), and sixty-five French companies.

Although the fields of Mesopotamia are very promising, production cannot reach a peak until better transportation facilities are completed. One thing necessary is the construction of a pipe line 700 miles in length from Iraq to the Mediterranean. The country is primitive and work is carried on under armed guards and adverse weather conditions.

Any further consideration of the situation in this district would lead to a survey of the complicated diplomatic controversies that immediately followed the treaty at Versailles. It is to be hoped, however, that the participation of the American groups in this international exploitation of Mesopotamian fields will make for better political and economic amity between the four countries involved.

The competitive situation in the oil industry obtains in the small countries of Central America and in some of the more powerful states of South America, but the

exploitation of the fields has not been rapid, due to political disturbances, and in many cases due to the inaccessibility of the fields. In most cases the various countries in Latin America have leasing laws modeled after those in the United States. In Argentina the mining laws have been extended to the leasing of oil lands. Peru has a zoning law, the size of the concession increasing as one leaves the coast, while rentals and royalties decrease. Some of these countries have export duties, others do not.

In 1918, the British Controlled Oilfields was granted a large concession in Costa Rica by the Tinoco régime. In 1921 Tinoco was deposed and the new government declared previous concessions null and void and immediately granted extensive concessions to two American companies—the Doheny and Sinclair groups. So far, however, Costa Rica does not rank as an oil producing state. Recently the Costa Rican government annulled all concessions and declared oil fields to be the property of the nation. This same condition is true of San Salvador, Honduras, and Panama. Granting the present difficulties of the political situation in Costa Rica, it may be taken for granted that, if oil companies find deposits in sufficient quantities to warrant drilling, the British or American interests will take the necessary steps to obtain the concessions.

The American interests in Venezuela control about 40 per cent of the capital invested, and the political situation is favorable. In the Dutch West Indies production would be much greater were it not for the poor harbor facilities in Maracaibo Bay.

Fairly satisfactory conditions exist in Colombia. However, since the oil fields are at some distance inland, the question of transportation is a complicated one. The Standard Oil has an active subsidiary in the International Petroleum Company. This company has laid a pipe line from the oil fields to the Magdalena River, and from this point flat-bottom tankers take the oil to the coast. In 1927 the production amounted to about fifteen million barrels. Since American companies own practically all the concessions in Colombia, the competitive situation is less severe than elsewhere. However, legislation is now pending in the Colombian Congress to nationalize the industry. Upon the outcome of this political gesture depends the success or failure of the American oil interests in this field.

Oil fields exist in the Argentine, principally to the southward, but all wells are state owned and exportation is prohibited.

Three remaining states, Ecuador, Bolivia, and Chile, have deposits of oil, but whether oil extraction will prove profitable depends upon the ability of the producers to overcome transportation difficulties. Undoubtedly Standard Oil believes in the future of the Bolivian fields since this company has bought up the principal production areas. No deposits of any value have as yet been discovered in Brazil.

IV.

The political fight for oil is entirely a modern phenomenon. Governments looked at the situation as a purely economic one when oil was being used as an illuminant and then as a source of power for vehicles and power plants. The only action of the state was legislation to check the extensive formation of trusts. But this was purely a social problem entirely divorced from any aspect of international relations. This attitude changed rapidly as the need for oil in commercial and naval vessels became apparent. Then began the development of the dreadnoughts and superdreadnoughts. These ships were fast, and developed great horsepower without sacrifice of armor or armament. It was natural that this advancement in ship construction should necessitate greater motive power derived from fuel other than coal. The result was increased cruising radius provided by fuel oil, with its susceptibility to stowage. But even with these known advantages the so-called great powers were hesitant in adopting oil as a naval fuel.

The outbreak of the World War found England with a very considerable proportion of her fleet dependent upon coal, while no large German vessel was constructed to burn oil. Great Britain was reluctant to change to oil for the reason that her whole naval and foreign trade policies had been built up around British coal; and British coaling stations were strategically located throughout the world. However at the close of the war, 48 per cent of the British fleet was using fuel oil, and it has been estimated that of the 10,000,000 tons of fuel oil imported to Great Britain during the war,

9,100,000 tons were used by the Admiralty.

By the beginning of 1917 the Germans realized the part that oil was playing in the determined stand of the Allies and the German submarines were particularly active against tankers for the next few months. Since the French Army used approximately 35,000 tons of petroleum every month during the war, and the British Army 23,000 tons, the possibility of a petroleum shortage in 1917 was indeed a critical one.

At the beginning of the war France owned only a limited number of tankers and her port facilities for handling oil were inadequate. The Germans disposed of the French tankers by the spring of 1917, and the French government began to fear a shortage of oil and its effect on the conduct of the armies. On December 15, 1917, Clemenceau wrote President Wilson to the effect that "a failure in the supply of petrol would cause the immediate paralysis of our armies, and might compel us to a peace unfavorable to the Allies . . . obtain from American oil companies tank steamers with a supplementary tonnage of 100,000 tons . . . request immediate dispatch to French ports of these tankers . . . the safety of the Allied nations is in the balance."

In the meantime Germany was forced to the use of petroleum substitutes, and the almost forgotten industry of oil extraction from shale and coal was revived. In fact the benzol extracted from coal tar was used as the chief fuel for motor vehicles, aëroplanes, and submarines. This serves as an illustration of what may be done to overcome a future shortage of natural oils, although there are no available figures as to the actual costs of production by these methods. At any rate, costs mean little under the circumstances.

In the autumn of 1917 the Interallied Petroleum Council was formed. This council consisted of representatives of Great Britain, France, Italy, and the United States, and was formed to control the transportation and distribution of oil. Immediately following the Armistice this council was dissolved, but Great Britain and France still maintain a control of this nature.

V.

The future of the petroleum industry from the point of view of actual resources is not of interest here because we know as little of the geological aspects of the potential producing states as heretofore. The interesting feature seems to be the regrouping of the national oil interests and the trend of the leading powers toward self-sufficiency.

The United States is still the greatest oil market and may be expected to be so for an indefinite period. The distance from foreign fields gives its product a comparative advantage from an economic standpoint over the inroads of foreign oils. At the same time this distance factor gives the American producer an advantage over foreign competitors in the development of Central and South American fields. Since the oil industry is still in its infancy, it appears that this regrouping in the industry, aside from any political aspects, is the natural economic movement brought about by costs as measured by distance. The success of American producers in Russia and Mesopotamia would seem to rest upon their ability to dispose of their products in adjacent markets.

COMMODORE RODGERS AND THE BUREAU SYSTEM OF NAVAL ADMINISTRATION

By U. T. Bradley, Instructor of History, Pomfret School

THE adoption of the present bureau system of administration in the American Navy was the result of half a century of experience with less efficient methods. The first congressional act for the government of the Navy under the Constitution, passed in 1799, placed the entire administration of naval affairs in the hands of the Secretary of the Navy, with one financial assistant, a naval accountant.

With the growth of the Navy during the War of 1812 the duties of the secretary under the original law rapidly outgrew the capacity of any single man, and brought problems with which a civilian was unfit to deal without professional assistance. On one occasion $60,000 was spent in rearranging the interior of a vessel because a civilian head of the department, lacking both advice and knowledge, had approved her original plans. The increase in the business of the department is shown by the fact that during the war expenditures grew from $1,970,000 to $8,660,000. President Madison wished to place a naval officer in charge, but Commodore John Rodgers, to whom he offered the position, preferred to go to sea and the President gave way. Congress took a step forward in 1815, attempting to care for the increased business by the appointment of the board of Navy commissioners to care for the entire question of material. Each of the three members of the board was to be a captain and receive $3,500 a year, the senior member acting as president. A set of duties was enumerated, giving the board charge of such activities as the planning, construction, and equipment of vessels, their armament and classification, the purchase of all stores and material, the preservation of ships in ordinary, the construction and maintenance of all docks, arsenals, timber sheds, etc., and the feeding and clothing of the entire personnel. It was further stated that nothing in the act should be so construed as to remove from the hands of the Secretary of the Navy the entire control of the department.

The first commissioners were Captains Rodgers, Hull, and Bainbridge, with the first named as president. Their first month in office was spent waiting for President Madison to settle a dispute with Secretary Crowninshield over a conflict of authority. This question settled in favor of the cabinet officer, the board assumed its duties and during the first years of its existence seems to have been a great improvement over the old system under which the civilian secretary was expected to be a "Jack-of-all-trades." Several progressive suggestions were made by the original board, among them the foundation of a naval school, the erection of a gun factory, and the elimination of unfit officers. All were eventually adopted, but not until after the abolition of the body that suggested them.

In 1829 the Secretary of the Navy, John Branch, asked the commissioners for suggestions toward the improvement of the administrative machinery of the Navy. Commodore Rodgers' reply is an excellent review of the commission system as it was operating at that time.

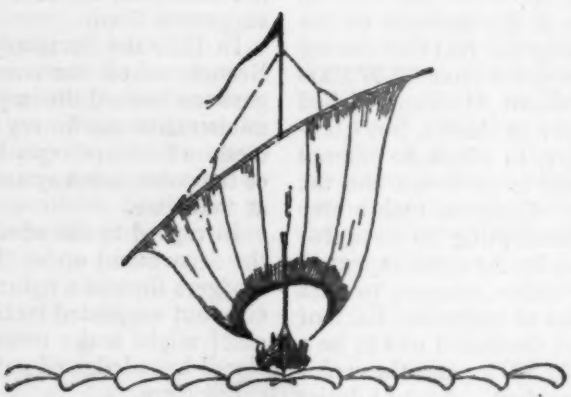
In regard to the administrative branch of the department under the secretary himself, Rodgers showed a natural reluctance to criticize, but suggested tactfully that the civilian chief might make more use of the professional knowledge of naval officers in technical matters.

The commodore's suggestions concerning the commissioners were important because they foreshadowed the later bureau system. His chief objection to the procedure in vogue was that the board was always forced to act collectively, though there were many matters that could best be dealt with by individual experts. On questions of policy Rodgers admitted that consultation was wise, but he contended that a man trained in matters of

ordnance, for example, could best carry out alone the everyday duties connected with that branch of equipment. He suggested the division of the board's duties into three groups: first, building, repair, and equipment; second, construction of docks, arsenals, and store houses, and attention to yards; and third, victualing and clothing. One commissioner should be placed at the head of each group, and each would soon become an expert in his own field.

It was not until thirteen years later that Commodore Rodgers' suggestions were adopted and the bureau system of administration inaugurated by the Navy. Meanwhile the War Department, under the secretaryship of that great South Carolina statesman, John C. Calhoun, in the administration of President Monroe, had been reorganized in this way with great improvement in both economy and efficiency. In 1842 the five original bureaus were created as follows: 1, navy yards and docks; 2, construction, equipment, and repair; 3, provisions and clothing; 4, ordnance and hydrography; 5, medicine and surgery. Thus began the bureau system that, with modifications, continues to this day. There were immediate objections to the system as originally organized, as when Secretary Upshur discovered that it was impossible to find one man fitted to take charge of both equipment and repair. The former required a naval officer, he declared, the latter, a carpenter. He chose the officer and trusted to luck for his carpentry.

Since the adoption of the system there have naturally been both modification and expansion, but it is to Commodore Rodgers that the origin of our present system of naval administration must be credited, for the spirit of the bureau system is present throughout the letter which he wrote to Secretary Branch in 1829.



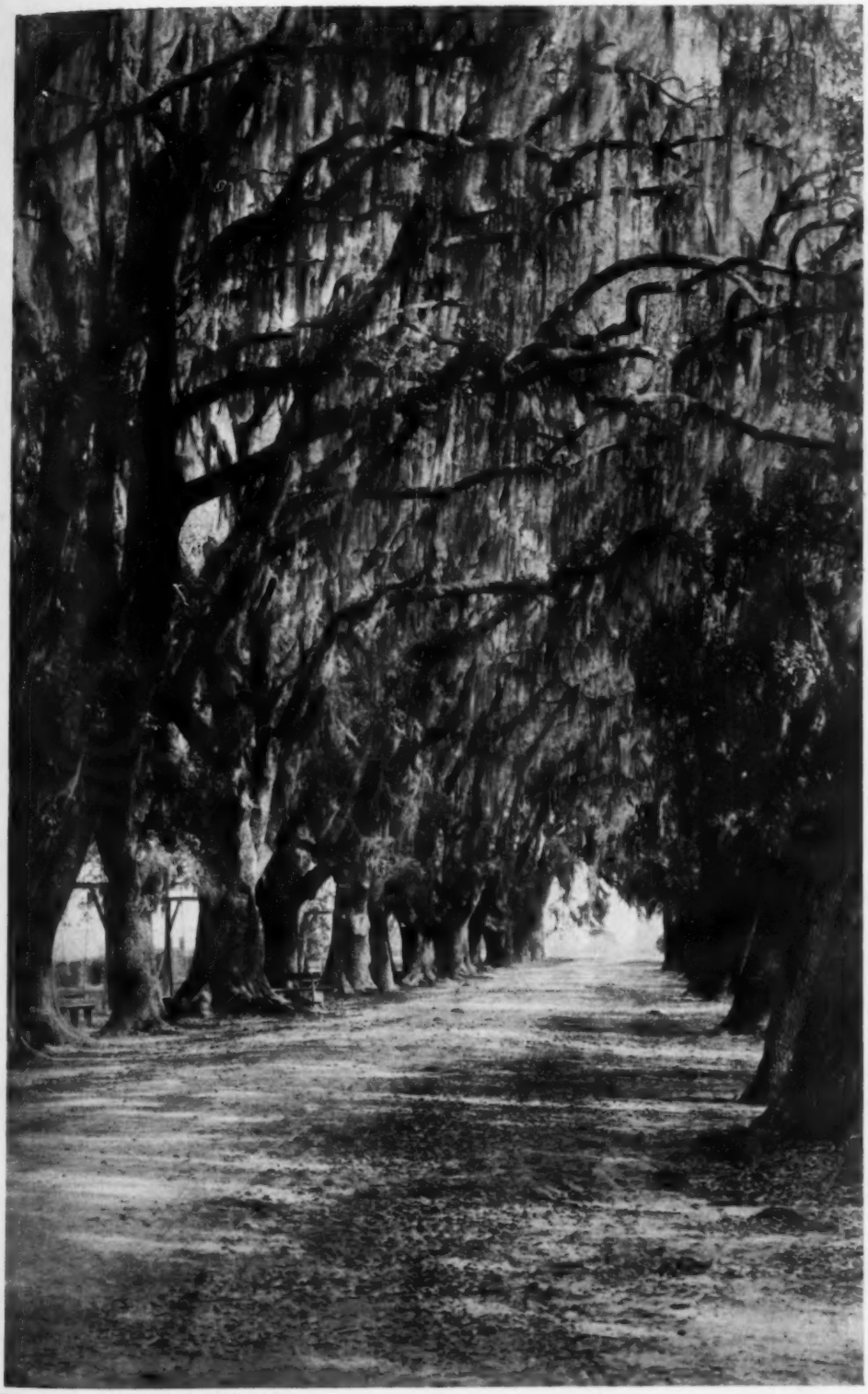


Photo from Ewing Galloway, New York

AUDUBON PARK, NEW ORLEANS
An avenue of live oaks.

By Ewing Galloway, New York

SOME OF THE REASONS FOR NEW ORLEANS GROWTH

By Ewing Galloway, New York

SOME OF THE REASONS FOR NEW ORLEANS GROWTH

From Ewing Galloway, New York

NEW ORLEANS MOLASSES

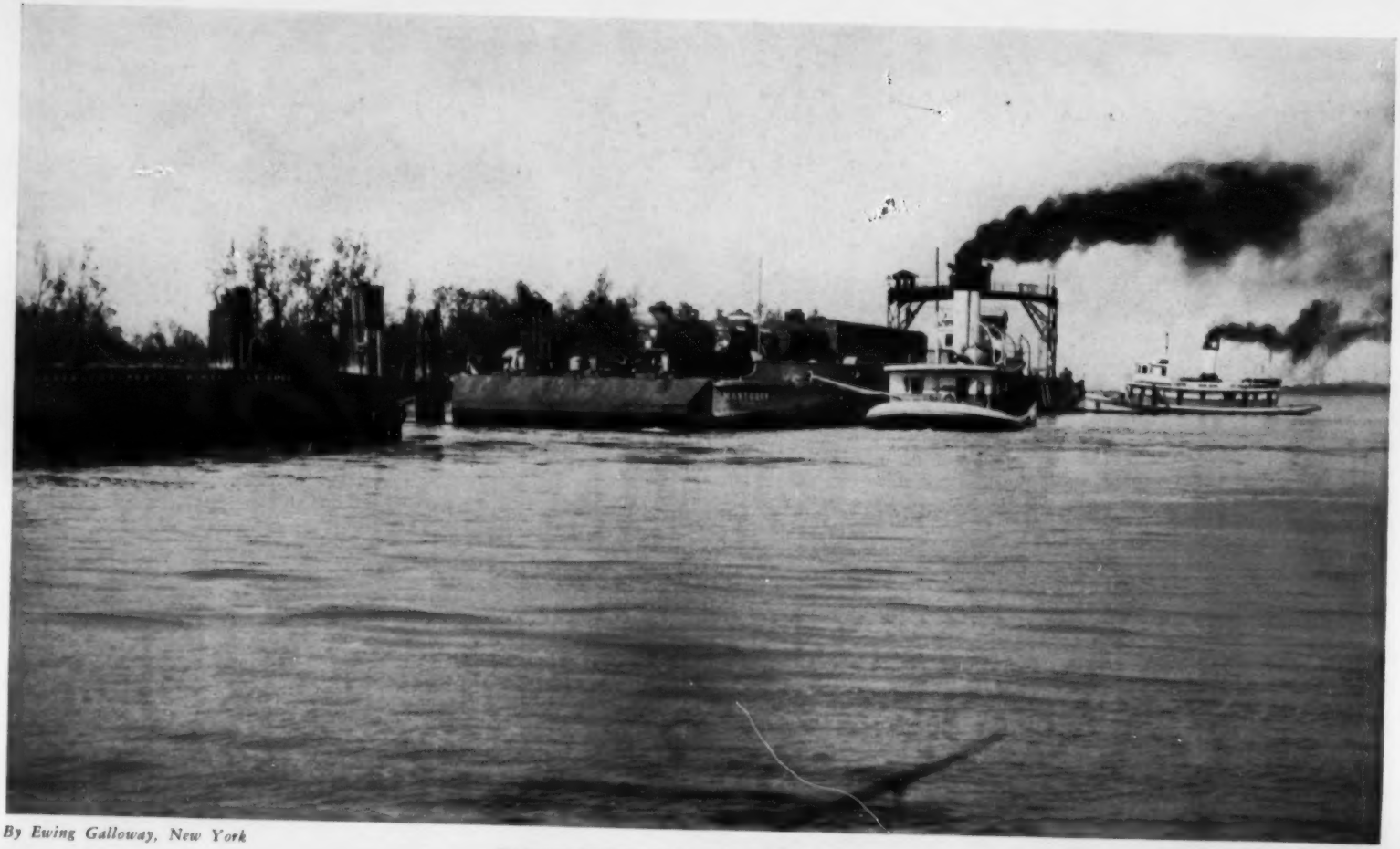
By Ewing Galloway, New York

ALONG THE NEW ORLEANS WATER FRONT

By Ewing Galloway, New York

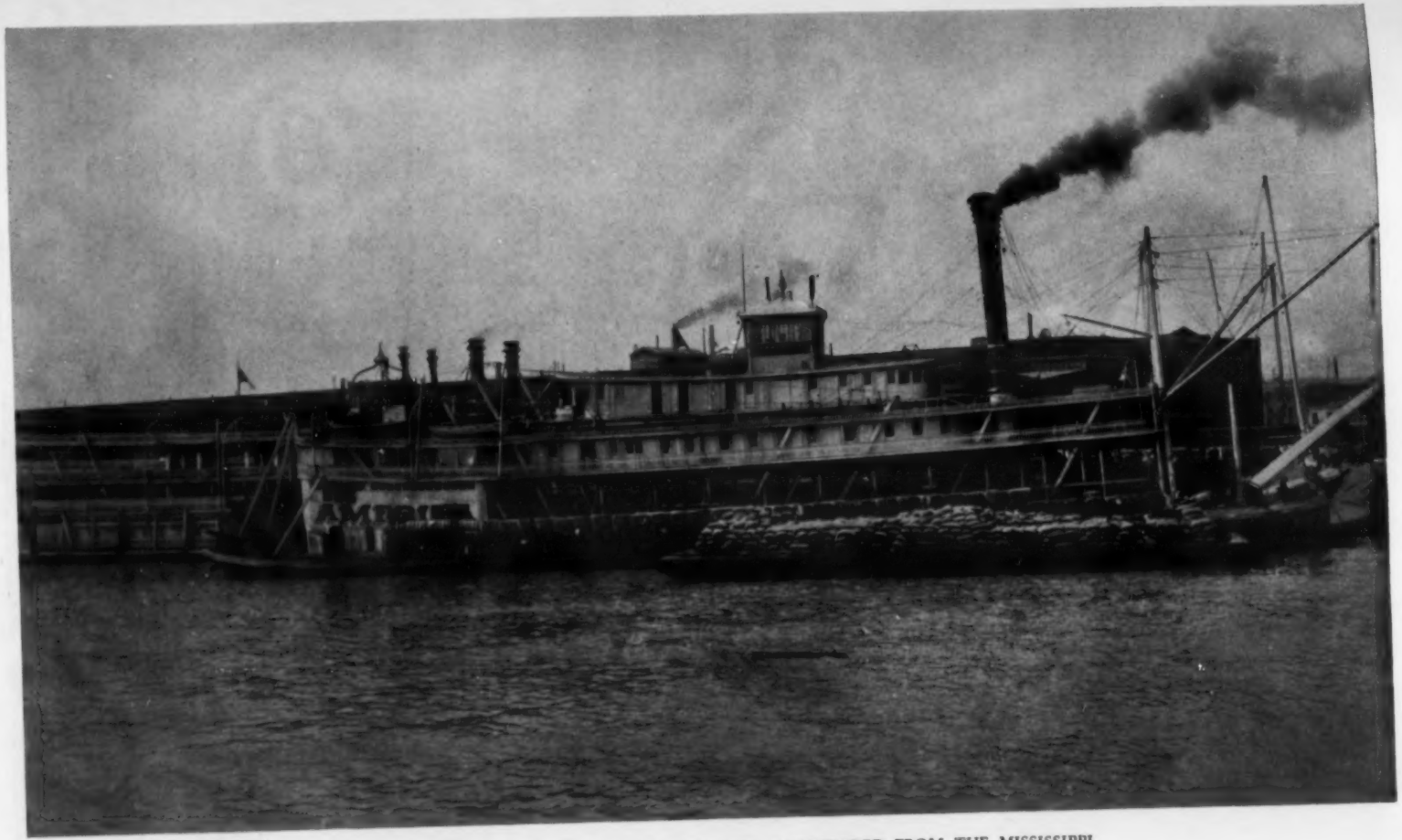
ALONG THE NEW ORLEANS WATER FRONT

By Ewing Galloway, New York PART OF THE NEW CHANNEL CONNECTING LAKE PONTCHARTRAIN WITH THE MISSISSIPPI RIVER



By Ewing Galloway, New York

FREIGHT TRAINS CROSSING THE MISSISSIPPI



By Ewing Galloway, New York

THE OLD-FASHIONED STEAMBOAT HAS NOT YET DISAPPEARED FROM THE MISSISSIPPI

By Ewing Galloway, New York

SOME OF THE SHIPS THAT BRING 20,000,000 BUNCHES OF BANANAS TO NEW ORLEANS EACH YEAR

SOME OF THE SHIPS THAT BRING 20,000,000 BUNCHES OF BANANAS TO NEW ORLEANS EACH YEAR

THE NAVY'S SULPHURIC ACID PLANT

By H. M. Coster, Superintendent Acid Plants, Naval Powder Factory

THIS plant is a part of the Naval Powder Factory located at Indian Head, Maryland. It was built in 1918 by the du Pont Company at a cost of about three-quarters of a million dollars and has a rated capacity of 70 tons 100 per cent sulphuric acid per twenty-four hours. It is of the Grillo-Schröder contact type, with the usual platinum on magnesium sulphate contact mass; burns sulphur to sulphur dioxide (SO_2), converts the SO_2 to sulphur trioxide (SO_3), absorbs the SO_3 in sulphuric acid (H_2SO_4), and delivers this as fuming acid or oleum of a strength which may be expressed either as 50 per cent free (dissolved) SO_3, 90.82 per cent total SO_3 or 111.25 per cent (100 per cent H_2SO_4).

It is in constant operation twenty-four hours a day and has been since it was started in December, 1918, except about eleven months in the fiscal year 1924-25 and one week in 1929. At present, the yearly production amounts to about four and one quarter million pounds of acid as 100 per cent H_2SO_4. Each pound of smokeless powder requires more than two pounds of sulphuric acid.

This plant operates on the same basic principle common to all plants of this type, but in modernization and scientific application of certain principles as developed and installed here, it appears to stand out above other acid plants. It is these special developments which will be discussed in the order in which apparatus has been installed.

In 1922 in conjunction with the Bureau of Standards, the first sulphur dioxide recorder in this country was developed and installed. This recorder operates on the thermal-conductivity principle for gas analysis. This method is based on the difference in the ability of the various gases to conduct heat. If a wire is surrounded by a gas which is contained in a chamber, the walls of which are maintained at a constant temperature, and is then connected to a source of constant electromotive force, the temperature of the wire will rise until a state of equilibrium is reached. The continuous dissipation of thermal energy is then equal to the electrical energy supplied to the wire. The dissipation of energy is accomplished by radiation, by conductivity through the connection to the ends of the wire, by currents of gas circulating in the atmosphere surrounding the wire (thermal convection) and by conductance through the gas. Some heat is also carried away by the current of gas, in case there is a flow past the wire. It is difficult to ascribe to each the exact share of total energy dissipated, however, it is known that when the temperature of the wire does not exceed 400°C., radiation can account for only a small portion, and that when the distance between the walls of the chamber and the wire does not exceed 5 mm., convection is also a small factor. It is obvious, therefore, that by carefully arranging the conditions, all loss of heat except by conductance through the gas surrounding the wire can be reduced to a small proportion of the whole. Under such conditions it is evident that the equilibrium temperature attained by the wire will depend mainly upon the gas which surrounds the wire to conduct heat. By the comparison of the resistance of two similar wires surrounded respectively by a reference gas and a mixture of two gases of which the qualitative composition is known, the quantitative composition of the mixture can be rapidly and accurately determined after an empirical calibration has been made.

The comparison is made by a form of the Wheatstone bridge in which the two wires to be compared are connected in series as two adjacent arms of the bridge. The other two "ratio" arms of the bridge are variable resistances which adjust themselves to bring the bridge to a balance.

The recorder as installed consists of a Leeds and Northrup Company's four-point resistance recorder, a Bureau of Standards thermal-conductivity cell, an Edison battery,

and a purifying unit developed here. It has been in constant operation since 1926 and keeps before the plant a continuous record of the percentage of SO_2 in the entrance gas. In all this time no repairs have been necessary and no care required other than the usual weekly oiling, greasing, and battery charging. Today finds it operating perfectly and in a large measure replacing the well-known Reich starch-iodine test, a volumetric SO_2 determination requiring both special training for the operator and the use of expensive iodine and potassium iodide. With this continuous record before the operator, he is able to feed to the converter a gas of uniform SO_2 content, which in turn keeps an even load on the converter and insures a maximum conversion of SO_2 to SO_3.

In 1928 a method was developed and apparatus installed for determining the strength of fuming acid or oleum by conductivity measurements. Some conductivity measurements had been made in 1920, but these results did not appear to warrant further work; however, because of the ever present need for such a method, the problem was again taken up in 1928—and this time was carried to a successful completion. Before this, all the oleum tanks forming a part of the absorbing system had to be sampled daily and samples sent to the laboratory for analysis. The sampling of oleum is both dangerous and difficult, as this acid freezes at such a high temperature (109.3 per cent H_2SO_4 freezes at 95°F.) that sample lines are always filled with frozen acid and have to be thawed. Often the sample bottle breaks and more often the sample freezes in the bottle. The analysis is difficult and none too reliable and costs about $1.00 for each one made.

The conductivity of an electrolyte is not measured directly but is determined from a measurement of the resistance of the solution between two electrodes immersed in it. The reciprocal of the measured resistance is the conductance of the solution. The resistance of the solution is commonly measured by an alternating current Wheatstone bridge method employed by Kohlrausch. There are available Landolt-Börnstein tables for conductance vs. concentration of pure H_2SO_4 in distilled water. Leeds and Northrup of Philadelphia, Pennsylvania, checked some of these points and found that the relation between H_2SO_4 and conductivity over a range of 96-99 per cent shows a very appreciable variation in conductance for a given change in acid strength, and they developed cells and a recorder for this determination. But with oleum, i.e. acid above 100 per cent H_2SO_4, they found a sharp minimum in the curve and discontinued further work. It was at this point that experiments were made here to develop a conductivity method for oleum analysis.

With a homemade conductivity cell and a measuring unit consisting of a half-meter slide wire, resistance box, buzzer, dry-cell battery, and a telephone, the resistance values at a standard temperature on acid of strengths ranging from 0 to 120 per cent were determined. These values when expressed in a curve using ohms resistance as ordinates and acid strengths as abscissae, showed, as was expected, a sharp minimum at about 102 per cent, so that it was impossible to tell by measurements alone which side of the minimum you were on. However, as the particular problem here concerns the analysis of oleum in the absorption system and as this acid seldom varies more in strength than 102-111 per cent, its position relative to the minimum remains fixed and its values fall on that part of the curve which shows an easy rise at 102-106 per cent, a steeper rise at 106-109 per cent and a very steep rise from 110 per cent up, so steep that a difference of 0.15 per cent in acid strength makes a difference of ten ohms in resistance. Obviously, therefore, by conductivity measurements, the strength of this oleum can be determined with an ease and accuracy never before known.

A conductivity indicator with a range of 0.5 ohms to 1,000 ohms and designed to operate on A.C. current was purchased from the Leeds and Northrup Company. This simplified the conductivity measurements and enabled us to prepare a very accurate curve. To be of the maximum plant value the cells must be mounted directly in the acid inside the tank. In conjunction with the Leeds and Northrup Company, cells for this purpose were prepared. These cells are in general arrangement similar to those sold by that company for acid analysis up to 100 per cent, but in size and style are of a special design. They operate in pairs. One is known as the standard cell and is filled with acid of a strength somewhere near the concentration of the acid to be measured, and

together with the second cell called the measuring cell, is immersed in the tank of acid. Obviously when the acid is of the same strength as that of the standard cell, the ratio of the resistance will be equal to one. By employment of the standard cell, temperature compensation is entirely automatic. The difference in the readings of the two cells fixes the point on the conductivity curve.

The value of this system was immediately established. Cells were installed in all oleum tanks and connection made to the conductivity indicator. This made it possible to determine the strength of any of these tanks of acid in less than a minute, by simply throwing a switch, pressing a button, and reading the conductivity curve. Another great advantage is the application to temperature determination of the acid inside the tanks. This was previously done by mounting thermometers somewhere in the acid lines. Special thermometers were necessary; they were hard to read and none too accurate. Because the acid in the standard cell has a definite value for each temperature, tests were made over a wide range of temperatures and the values plotted. With this curve and the conductivity curve both the temperature and the strength of the acid are now read off in one operation.

The increased safety to the men in handling so dangerous a product is important; the saving in the cost of $1.00 for each analysis is important; but these mean little as compared to the value to the absorption system, for it is here that condition of temperature and strength of acid must be carefully controlled and maintained in order to secure the maximum absorption of SO_3. This conductivity system as installed, acts as an eye, for mounted right into the tanks of fuming, whirling oil of hell, it remains but to press the button and see directly the way to maximum SO_3 absorption and maximum yield.

In 1930 there was developed and installed a system for adding the necessary water to the absorbing system in the plant. In the absorbing system, SO_3 gas passes to five absorbing towers, two connected in parallel and three in series, with each fed by its own tank of acid. The strengths of these acids are allowed to build up in all units except the last. In this the strength is carefully maintained as near to 98.3 per cent as possible, as this acid has first a minimum vapor tension of SO_3 and so is able to extract the SO_3 completely from the gas, and second, it has a minimum vapor tension of water and so causes no mist formation.

In the old system the water was added from time to time in the form of weak acid which was made especially for the purpose by mixing together strong acid and water. This required, however, much of the operator's time and in addition employed a whole system of pots, coils, boxes, and pumps, all of which had to be constructed out of chemical lead. Because of the strength of the acid and the heat formed by mixing the acid with water much time and skilled labor were required to keep this system operating.

In the new system, suction is produced by by-passing a part of the circulating acid directly to the cooler, thence to the tank without first passing over the absorption tower. Into this by-pass line is connected a line from a steam chamber made out of 3-inch pipe and fed by a ¼-inch steam line. The suction in the by-pass line draws from this chamber steam and water which are quickly absorbed by the rapidly moving acid. A valve on this line controls the quantity of acid by-passed and therefore the amount of suction. Once the valve is set, the system remains practically automatic as steam and water continue to be drawn in at a uniform rate until the valve is changed.

In brief, the operation of the new system is distinctly simple and practically automatic. It introduces water in the system in such a way that the formation of H_2SO_4 mist is reduced to a minimum and the absorption of SO_3 increased to the maximum. The cost of the new system is about 1 per cent of the old and has an upkeep that follows out in like proportion.

The plant has produced since it was started in 1918, over 51,000,000 pounds of acid and maintained an all time conversion of 95 per cent and a yield of over 94 per cent. In all this time there has been very little acid loss and but a slight injury to one operator. After producing such corrosive material for so long a time, the plant still stands today in excellent shape, ready, almost over night, to increase its production more than ten times. It is equipped with apparatus that makes adjustment simple, control easy, operation definite; things which make the Navy's plant a leader of acid plants.

GENERAL DESCRIPTION OF THE INDUSTRIAL ACCOUNTING SYSTEM

By Captain William S. Zane (S.C.), U. S. Navy

THE accounting system prescribed for industrial navy yards embraces two phases; appropriation accounting or the determination of appropriation costs, and cost accounting or the determination of industrial or an approximation of actual costs.

The more important phase is appropriation accounting, since it is through this that expenditures become charges to the proper appropriations and the several bureaus of the Navy Department exercise control over their appropriations. Cost accounting is an extension of appropriation accounting, designed to give an approximation of actual costs for purposes of comparison between navy yards and between the Navy and private business.

Appropriation accounting: (See articles 600 to 649.)[1] This phase of the accounting system is designed to accomplish two major objects; viz., (a) the reporting of expenditures in such form as to indicate the appropriations legally chargeable with them, and (b) the furnishing of information relative to expenditures in such form that the Navy Department may determine the purposes for which its appropriations were expended and the actual expenditures for each purpose. Reporting expenditures for charges to appropriations necessitates recording them in such manner as to permit this. For the naval service generally, the first step towards this end is the assignment of distinguishing "accounting" numbers to each appropriation and to each ship and shore activity. The second step is the division of the whole field of naval expenditure into classes of like purposes under what are termed, "titles."

Thus, by requiring all activities that spend appropriations to record and report expenditures under the accounting numbers representing the appropriations chargeable; under the accounting numbers of the ships and stations by or for whom the expenditures were made; and under the proper titles, the Navy Department can, by combining all reports of expenditures: (a) report total appropriation expenditures to the general accounting office for charging to the proper appropriations, (b) determine the total cost of operation of each ship and shore activity of the Navy, and (c) determine both by individual activities and as a whole how much is spent for new construction, title A; for operation of vessels, title C; for maintenance of industrial navy yards, title G, and so on. (See article 503-2 for complete list of titles.) This, briefly, is the purpose of appropriation accounting. There follows the manner in which it is accomplished at industrial yards.

For administrative purposes, which serve also for accounting purposes, the industrial yard is divided into two main classes of activities, viz., *productive* activities, which are the shops engaged in repair work and manufacturing primarily for the fleet; and *nonproductive* activities, which are those which carry on other functions of the yard. The nonproductive activities are of two kinds, viz., military and industrial. The former include the receiving ship, the communication service, etc., which in no way contribute to productive work. The latter include the power plant, the transportation system, administration, planning and estimating, etc., which *do* contribute to the productive work of the shops. (See article 605-2 b.)

For accounting purposes, there is prescribed for each nonproductive activity a set of expenditure-purpose headings termed "accounts" under which all expenditures are recorded. Each "account" is assigned a dis-

[1] References in the text are to the *Bureau of Supplies and Accounts Manual*, unless otherwise stated.

tinctive designating number which indicates the expenditure-purpose heading and the activity chargeable. Expenditures on behalf of the nonproductive activities constitute what is termed "general expense" and because the "account" numbers of these activities all begin with an "O," this number signifies "general expense." That portion of the "general expense" incurred in the maintenance of the military activities is termed "general expense, military," while the remainder is "general expense, industrial," but when the term "general expense" is used without qualification it should be taken to mean "general expense, industrial," which it does mean hereinafter.

Similarly, the productive activities, the shops, have each their own designating number and the purposes for which expenditures incident to their operation may be made are designated by "account" numbers. These "account" numbers always begin with the letter "X," which signifies "shop expense." (See article 605-2 b 2.)

At this point, it is necessary to develop a fact which has a very important bearing on appropriation accounting, viz., that while expenditures for certain purposes are legally chargeable to one appropriation only, there are other purposes for which several appropriations are available. Thus "maintenance, yards, and docks" is the only appropriation available for the repair of a building. The appropriation "construction and repair" is the only appropriation chargeable with repairs to the hull structure of a vessel, "engineering" only is chargeable with repairs to the machinery of a vessel, and so on. On the other hand, all these appropriations are available for such items of expenditure of an overhead nature as shop supervision, planning and estimating, power, yard transportation, shop maintenance and supplies, janitor service, etc.

Thus, expenditures fall into two distinct categories; first, those which only a single appropriation can bear and second, those which several appropriations may bear in common. The first class are called "determinate" charges because the appropriation chargeable is definitely known, there can be no other; the labor involved in such expenditures is termed "direct" labor and the material "direct" material. The second class are called "indeterminate" charges because they are not restricted to one appropriation; the labor involved in them is termed "indirect" labor and the material "indirect" material. This latter class constitutes what is termed "appropriation overhead."

Under both "general" and "shop" expense, both "determinate" and "indeterminate" expenditures occur. "Determinate" general and shop expense charges are distinguished from the "indeterminate" charges by prefixing the appropriation number and the title to the account number on all papers covering labor and material expenditures of a "determinate" character. Such account numbers are called "determinate accounts." Similar papers covering "indeterminate" charges bear only the "account" numbers without appropriation designation. Their "account" numbers are spoken of as "indeterminate accounts." Thus, the accounting office receives daily the "determinate" general and shop expense charges which it records under the appropriations, titles, and determinate accounts properly chargeable; it also receives daily the "indeterminate" general and shop expense charges which it simply records under the "indeterminate account" numbers, which show the activity and purpose for which the expenditures were made. How these "indeterminate" general and shop expense charges become appropriation charges will become apparent later.

So far, there have been discussed only two of the three major classes of expenditures at industrial navy yards, viz., general expense charges or those for the maintenance of the nonproductive activities and shop expense charges or those incident to the operation of the productive shops. There is a third and equally important class of expenditures, i.e., those entering into the output of the productive shop. This is the money spent for labor and material entering directly into the repair and manufacture work performed by the productive shops. Such work is termed "productive" work and the labor entering into it "productive labor." The expenditures for productive work are always "determinate" in character. Any one of the productive shops may be called upon to perform work on a vessel, for any one of the nonproductive activities of the yard, and for itself, or another productive shop. By requiring the papers covering the labor and material entering into such work to bear the appropriation number, the title, and the

accounting number of the vessel or other activity for which the work is done, the accounting office can record the charges under the proper appropriation and title and as an expenditure on behalf of the vessel or activity concerned.

At this point it is advisable to consider how this money is obtained, how it is converted into expenditures, and how these expenditures are reported to the accounting office for recording.

The yard obtains its funds for all purposes by allotments made by the bureaus concerned from the appropriations under their cognizance.

Under these allotments, job orders (N.S.O. Form 106) are issued by the officials of the yard responsible for the work contemplated by the allotments. (Routine maintenance expenditures for the nonproductive activities and the shops are not covered by job orders, as the expenditure purpose headings or "accounts" are considered sufficient authority for such expenditures.) Job orders are the authority to proceed with the work which is set forth in detail on them. (See article 604 for details regarding job orders.)

When job orders reach the accounting office, final cost record sheets, one for each job order, are opened to which is to be posted the expenditures made thereunder.

Since *all* expenditures must be for either labor or material the system must provide for reporting these in such manner as to permit of recording by job orders or accounts, as the case may be. This is accomplished as follows:

For labor: A time ticket (or time card) is sent by each activity employing labor to the accounting office each day. If an employee works on the same job the full day, only one time ticket is prepared for him. If, however, he works part of the day under one job order and the remainder under others, a separate time ticket is required covering the time actually put in under each job order. The time tickets bear the job order number or "account" number under which work is performed; the employee's name; his pay number; hours worked and their value or pay earned. The time tickets go first to the time (or pay roll) section of the accounting office where each employee is credited on the roll with the pay earned. They next go to the "cost" section for sorting by job orders, which indicates the appropriation, title, and accounting number chargeable in the case of "determinate" charges or by "account" only, in the case of indeterminate charges and for application of the "shop rates," which is discussed hereinafter. They are then posted to the appropriation ledgers from which the labor is posted to the job order final cost record sheets monthly.

For material: Material is drawn from store for use on work authorized by job orders or "accounts" by means of stub requisitions (S. and A. Form 192) (See article 1161-2). These bear the job order or "account" number; a complete description of the material required and the quantity. The supply department issues the material; prices, extends, and totals the stub requisitions, and each day turns over those completed to the accounting office where they follow the same course as do the time tickets, except, of course, they have no connection with the shop rates or the pay rolls.

Thus, the accounting office daily records all "determinate" general and shop expense and all expenditures for productive work (which is always "determinate") by appropriation, title, and accounting number, but records the "indeterminate" general and shop expense by "accounts" or expenditure purposes only. It was pointed out that this "indeterminate" expense was of a category which several appropriations can bear, such as expenditures for shop supervision, for shop supplies and maintenance, for planning and estimating, for power, for yard transportation, etc. Without such services the productive shops could not have produced. It therefore follows that such expense should enter into the cost of the output of the shops but it is evident that it cannot be recorded directly under productive job orders as is the case with the labor and material directly expended under them. For example, a shop may be engaged simultaneously on fifty distinct jobs under six different appropriations. The shop supervisor, the foremen, the leading men, the tool repair men, the janitors, etc., are not working on any particular job; they are assisting in the work of the shop as a whole. Obviously, therefore, time tickets cannot be made out for them showing the time actually spent on each of the fifty productive jobs in progress. The same is true with respect to the other

elements of general and shop expense, i.e., administration; planning and estimating; power used by the shop; general shop supplies; etc. Consequently, expenditures for such general purposes must be charged indirectly, since they cannot be charged directly. This is accomplished as follows:

At the end of each month the indeterminate general expense (less power cost) is prorated to the productive shops on the basis of the value of the productive labor of each shop for that month. It is then merged with and becomes a part of the shop expense. Since the power used by each shop can be determined by meter or otherwise, its value is computed and similarly transferred to each shop where it also is merged with the shop expense. This procedure, which is termed "general expense transfers to shop expense," has the effect of combining the indeterminate shop expense, the indeterminate general expense, and the power charge into one figure for each shop representing the total indeterminate expense which is to enter, with the direct labor and direct material, into the cost of each productive job order and thus form the appropriation cost of each productive job.

This latter is accomplished by arriving at percentage rates which, when applied to productive labor time tickets, will give a figure approximating the share of the total indeterminate expense which legitimately goes with such productive labor.

Such percentage rates, termed "estimated indeterminate appropriation shop rates" but commonly called "shop rates," are established at the beginning of each fiscal year for each shop.

Assuming that a shop rate of 20 per cent was decided upon by the local accounting board whose duty it is to arrive at shop rates, this rate is thereafter applied daily to all productive labor time tickets of shop 31.

Thus, each day, in addition to recording the direct labor and direct material, the accounting office records as a charge to each appropriation, that appropriation's share of the "indeterminate" general and shop expense as determined through the application of the shop rates to the productive labor. But this figure is not actual as it resulted from estimated shop rates. Therefore, it is termed the "estimated indeterminate expense" to distinguish it from the actual indeterminate general and shop expense figure which had been obtained by actually recording the time tickets and material stubs under the "indeterminate" accounts. These two figures should closely approximate each other, but will never exactly agree. When the day's tabulating has been completed, the accounting office compares the actual with the estimated indeterminate figure for the day. If the actual exceeds the estimated, it shows that the application of the shop rates to the productive labor for that day failed to absorb all the indeterminate expense of that day. This difference is called an "underabsorbed" figure and since it represents an expenditure it must become an appropriation charge and accordingly the appropriations concerned are debited with it. If the actual is less than the estimated indeterminate, an "overabsorbed" figure results which is disposed of by crediting the appropriations concerned. This adjusts the estimated to the actual indeterminate figure and hence the exact indeterminate expense for the day has been distributed to the appropriations paying for productive jobs.

Through this process, the accounting office is enabled to record each day every penny expended for naval purposes under the proper appropriation, title, and the activity concerned. At the end of each month it reports them to the Navy Department and the bureaus concerned, for ultimate charging to appropriations. The use of the shop rates permits of the accomplishment of other important matters which the mere proration of the indeterminate expense to appropriations on the basis of productive labor would not permit, viz., (a) It carries the indeterminate expense into the "daily report of appropriation expenditures" by which the accounting office daily advises those responsible for allotments of the charges lodged against them and the balance available for expenditure; (b) it carries into the cost of each productive job that job's approximate share of the indeterminate expense; (c) it provides an accurate means of estimating the indeterminate involved in contemplated work, since all that is necessary is to multiply the estimated productive labor by the correct shop rate to secure the estimated indeterminate.

The foregoing presents, in general terms, the system prescribed for effecting appro-

priation charges and determining "appropriation" costs which, together, constitute "appropriation accounting."

Cost accounting: (See articles 650-659). "Determinate" expense, of which the more important items are: pay of officers supervising work, pay of the clerical force of the yard, cost of new buildings, repairs to buildings, etc., would all, in a private business, be figured into the cost of its product. So also would depreciation of plant and machinery, employee liability insurance, etc.

Hence the Navy, to arrive at a figure representing what would be the actual cost of productive work of a commercial concern, must include, in addition to the appropriation cost, a proper proportion of those "determinate" charges which, like the "indeterminate" charges, contributed to production but which, unlike them, had to be charged directly to other appropriations because they are of the character which a single appropriation only can bear. This "determinate" expense enters into industrial costs as follows:

The accounting office has recorded daily all expenditures for *all* purposes so that these are known over any prior period of time.

Each year, then, the figure representing the gross expenditure is taken. From it is deducted the appropriation cost of productive work and those charges of a strictly military nature which in no way contributed to production, including unutilized capacity of plant. To the balance thus obtained is added estimated figures representing depreciation of plant and machinery and employee disability, which would, in a private business, be figured into the cost of its output.

Having thus arrived at a net figure representing this statistical overhead, as it is termed, the proportion which it bears to the total "indeterminate" expense for the same year is determined on a percentage basis. That is, by dividing the statistical overhead figure by the "indeterminate" figure, a percentage rate is arrived at which, when applied to the "indeterminate" portion of the cost of productive job orders, will approximate each job order's share of the statistical overhead. This percentage rate is termed the "industrial (or statistical) overhead rate." Like the shop rates, the result of its application will give an "over absorbed" or "under absorbed" figure over a period of time but, as this has no bearing on the appropriations, it is only considered in the periodic revision of the yard's industrial overhead rate.

Thus, when each productive job order is finally closed, the final cost record sheet for it shows as its appropriation cost the direct labor, direct material, and the indeterminate entering into it. As its industrial cost the same sheet shows in addition to the appropriation cost, the Navy owned material used, and the statistical overhead.

The industrial cost of the productive job permits a comparison of the cost of like work between different yards but more important still, it enables the Navy to furnish cost figures comparable with commercial costs to Congress and other inquirers.

Other important functions performed by industrial navy yards, are:

Title Z shops: (article 661.) These are shops maintained for the manufacture of material for stock. They are financed from the naval supply account fund and their total cost of operation is figured into the cost of their output. Consequently, the naval supply account fund is reimbursed in full as such material is issued and charged to other appropriations.

Work for other government departments and private parties: (articles 664-665.) Such work, when duly authorized, is performed under the naval working fund, which is a self-maintaining fund, to which the cost of work is charged and to which the payments received therefor are credited.

WATER-TIGHTNESS

By H. W. Pierce, Former Lieutenant (C.C.), U. S. Navy

FROM the time the first rude boat was fashioned from a log, this being the first great step from the raft type where buoyancy was obtained by the use of solid timbers, water-tightness has been the prime requisite of water-borne carriers. Without it buoyancy and stability become relative, decreasing as water gains entrance and vanishing at some point set by the initial design. Where leaks are well within the capacity of the ship's pumps and drainage facilities, there is nevertheless the discomfort of a "wet ship," spoilage of cargo or stores, contamination of fresh water or fuel, and kindred ills. The tightness of the steel hull was one factor that drove the wooden ship from ocean trade. Absolute water-tightness of the shell, of fuel and water tanks, and of weather decks, is of first importance and receives such close attention that no further mention need be made herein. If leaks develop, as they will, they are discovered immediately and if beyond the capacity of the ship's force to repair, receive high priority during yard overhaul.

Early man progressed from his first adventures in sheltered waters or streams until he required larger and larger boats; finally his dugouts would no longer serve. Instead of a single timber, hollowed by fire or axe, a large number of pieces were used, fitted together to form the hull, and secured by lashings and trenails, finally made water-tight by rude caulking or by the use of gums. This type required some means of stiffening to hold the shell to its work, and maintain the ship form against water pressure and load. In the small boat the thwart served this function, but as size increased, and the need of subdivision of the space within the shell developed, these dividing bulkheads served to hold the sides in place. At this stage we find that bulkheads, both longitudinal and transverse, had two functions: the body of the ship was subdivided to provide better use of the space, forming holds, storerooms, staterooms, and other compartments; and further, these bulkheads in conjunction with the framing supported the shell and held the ship as a whole in shape. So far as water-tightness was concerned, the first and only line of defense still remained the planking or shell.

If these bulkheads, or certain of them, are built strongly enough to withstand water pressure at a head equal to or greater than that which would result from flooding, and further, are made water-tight, they can perform a third and very important function. In the event of damage to the shell, only the space bounded by adjacent and intact water-tight bulkheads need be flooded. The bilging is restricted and, assuming a sufficient degree of subdivision in the design, the ship should be able to make port, either under her own power or, at least, at the end of a tow-line. Structurally, and speaking in rather broad terms, a bulkhead designed to meet water pressure under bilged conditions will have ample strength to meet the requirements of its other functions. Water-tightness in such bulkheads presents a different and much more complicated problem than in the shell, due to the necessity of running pipe lines, electrical leads, or shafts through them, and providing access with doors, manholes, or bolted plates.

Obviously, it is possible to use a great many of these water-tight bulkheads, and make the subdivision so minute as to make a ship practically unsinkable. In the commercial vessel, however, subdivision is complicated by the demands of service. In the cargo-carrying class, holds must be of relatively large size, or the loading and unloading, as well as economical stowage, of cargo becomes too difficult. In passenger-carrying ships, similar complications are encountered; comfort is highly rated, and as a result there can be few divisions in the spaces used by passengers. Nevertheless, there is a growing opinion that better subdivision to keep the damaged ship afloat is worth more than an elaborate outfit of boats, some of which,

perhaps, cannot be launched when the emergency occurs, and which are unsafe at best, if weather is bad and a high sea running. In this commercial type of vessel the probable damage which necessitates some degree of water-tight division would be due to the normal hazards of the sea: grounding, collision, opening of seams due to racking in heavy storms, or failure of structure under some unusual stress; less frequently, to leaky or faulty ports and hatches, failure of piping or sea chests, or mishandling of valves.

Referring now to combatant types, the naval vessel is subject to all of the foregoing, and in addition, must be designed and kept in continual readiness to receive damage in battle. Whether this damage be due to shell fire, torpedoes, mines, or bombs, the ship must be able to sustain the maximum amount of damage, according to type, and not only remain afloat but fight, as well. Flooding must be restricted to a minimum at point of damage, for list and excessive trim must be corrected by counter flooding, in order that the ship may continue to fire. The punishment which the ship can take will depend first on the resistance to penetration of armor over vital areas, and secondly, to the extent of flooding, intentional or otherwise, which takes place in the unprotected portions. Compartments must still remain of reasonable size, consistent with the use to which they are to be put, and the total weight of hull structure cannot exceed certain limits. Subject to these limitations, naval ships of combatant type must be, and are, subdivided as minutely as possible.

Credit is generally given to very efficient water-tight subdivision, as well as protection, in enabling the German ships at Jutland to receive tremendous punishment and still remain in the fight, crippled more or less, but still in action and able to make port later. According to Captain Schelbe, ships with as high as twenty-five severe hits and extensive damage below the water line succeeded in making home ports. *The Goeben,* renamed the *Sultan Selim,* in another theater of the war, furnished a striking example. This ship suffered severely in an early action with Russia, and not long after struck a mine. In both cases she made port and could be repaired. At Imbros in 1918, she hit one or more mines, but was still able to proceed slowly until hit several times by aircraft. She was then beached, and while stranded, was subjected to several hundred attacks by aircraft. In spite of it all, the ship was refloated, made Constantinople under her own steam, and was repaired. Other instances are many where proper subdivision, in conjunction with proper upkeep, and smart handling of water-tight doors and hatches, have sustained a badly damaged ship. It is a proved fact that a large amount of comfort, ease of passage, and space is well sacrificed to obtain positive security against extensive flooding.

Water-tight subdivision can be, however, one of the greatest of snares and delusions. The notation "W. T." on the plan, or gleaming paint and glistening bright work may be of very little help when a compartment floods, and a thirty-five-foot head of water is working on a bulkhead. A surprising quantity of water can flow through a comparatively small hole when there is a little pressure behind it. And when these small holes and leaks are legion, as they are too apt to be after the ship has seen a number of years of service, the bulkhead for all its well-kept appearance is likely to look and behave like a kitchen sieve when the emergency occurs. There are too many instances where just that has occurred, although in some the flow was sufficiently dammed to permit the pumps to make some headway, or docking facilities and help were near enough to make salvage possible. In such cases the report may read ". . . . after engine-room slowly flooding . . . .," but the point is that those bulkheads were not damaged in the accident, and there should have been no flooding at all, following that immediately after the collision. In one case where magazine spaces were flooded intentionally to prevent fire spreading to powder, the water-tight integrity proved so poor that flooding had to be discontinued to avoid serious consequences.

A little calculating may serve to further emphasize the point. The quantity of water which will flow through a given orifice is expressed by:

$$Q = k\,A\,v = k\,A\,\sqrt{2gH}$$

in which:
- k = coefficient of discharge
- A = area of hole
- H = static head
- g = acceleration due to gravity

Using a coefficient of .9, and a head of 9 feet, and a hole 1 square foot in area, the quantity of water is found to be 9.500 gallons per minute, or, in terms comparable with the displacement of ships, at the rate of 2,200 tons per hour. If this one-foot hole is 25 feet below the water line, the rate will be found to be 3,700 tons per hour. Calculations of this nature form the basis of argument against the installation of a main drain, intended to free the ship of water in the event a large breach is made by explosion or collision. In modern installations, the main circulating pumps are usually connected to drainage lines in the engineering spaces, so that their large capacity could be utilized in case of serious leaks in this part of the ship. The remaining pumping facilities are intended to handle very much smaller quantities, service drainage, or leakage due to strained, but not ruptured, bulkheads. For example, in one case the combined capacity of the main circulating pumps is 60,000 gallons per minute but the main drain is only nine inches in diameter, so that only a small part of this capacity is available, and that only in the boiler- and engine-rooms. The combined capacity of all other pumps which could be used for pumping other spaces on the ship is somewhat less than 2,000 gallons per minute and this total is not available at any one location.

Reliance is therefore placed on the water-tight subdivision to localize the flooding, losing the buoyancy of one or more compartments, rather than on freeing the ship of water altogether. But assume that one of the bulkheads bounding this area is in the following condition: a voice-tube lead has been changed, and the original four-inch hole was not blanked. A hatch stanchion stowage was also removed, and the four bolt holes remain. Various small leaks in the structure, doors, and vents will bring the total area to about fifteen square inches. Further assuming a mean head of only ten feet, water will enter at the rate of over 1,000 gallons per minute. This is a rather bad case, but it is not impossible, nor unheard of, as it should be.

When a naval ship leaves the builder's yard it can safely be assumed that every part of water-tight structure is, for all practical purposes, water-tight. This is assured by the rigid schedule of compartment testing and inspection. Except in water and oil tanks, and shell, bottle-tightness is not required, nor, in many places, can it be obtained. Most fittings, doors, glands, and portable plates cannot be made absolutely tight, or if they were made so for test, would develop leaks after operation. The amount of leakage has been noted in a great many experiments, and a practical limit ascertained, which forms the basis of "allowable drops" in air testing. A compartment which tests within this limit will never cause trouble in the event it is flooded. The test requirements are set forth in the "General Specifications for Building Ships," and are amplified, with test heads and pressures given, in the "Detail Specifications" of each individual ship. In addition, each ship is furnished, when commissioned, with the results of the builder's tests. With these, and a Bureau of Construction and Repair booklet, *Air Test of Compartments*, every officer, and in particular the first lieutenant and his assistants, should be familiar.

The requirements of the specifications are carried out in a private shipyard as follows. As soon as the structural work of a compartment is completed, the contractor requests preliminary inspection by the superintending constructor's office. A special mechanic in his force goes over the tank in detail, checking against the approved plans to make certain that the work is in exact accordance. From his own experience in the trade, he is able to detect any evidence of poor workmanship, which must be corrected before he will certify the tank ready for pressure test. At this stage permanent doors, hatches, and manholes must be in place, but no piping, ventilation, or electrical leads are yet installed, and other holes, if any, are blanked. A "test sheet" prepared by the contractor from the data given in the "Detail Specifications," and approved by the bureau, gives the test head in water, or pressure if air is used, which is then put on in the presence of the inspector, and held until he is satisfied that the work is tight and shows no undue deflection. This constitutes the "Strength and Tightness" test, which is intended to check the structural work, both in design and workmanship.

Much later in the building period, and after every fitting, pipe line, cable, label plate and permanent article is installed, the inspector is called for a check on completion. The compartment is again checked against the plans to make sure that all work connected to, or through, the boundaries is com-

plete, and properly done, ready for the "Completion Air" test. The pressure in this test is usually somewhat lower than for the strength test, and is held for a definite period, usually twenty minutes. During this period, the air hose is disconnected, and the drop in ounces read on a mercury gauge. The inspector then submits a report to the constructor's office, giving the time, drop, and a list of the fittings, etc., if the drop is more than a few ounces. From this information, an "allowable drop" is calculated as described in the booklet *Air Test of Compartments*, and if this is greater than the actual drop, the test is passed. The compartment is then locked, and opened only with the inspector's knowledge for completion of painting, stowage of portable articles, and cleaning. Breaking a pipe line, running a new cable, or any alteration affecting the boundaries requires a retest. Finally, just before delivery, an inspection is made to determine cleanliness, condition of paint, stowage, etc., and not until then does the government accept that compartment as satisfactory. The routine has been described briefly here to indicate the thoroughness with which the new ship is made safe and tight.

It is unfortunate that the upkeep of the ship in service is apt to run more to good-looking paint and bright work on these bulkheads than to maintaining the original water-tight integrity. In fact, the one may assist in destroying the other. A water-tight door dog is not an easy matter to fit and make tight without working unduly hard. However, it is no easy matter to polish one in place. On how many ships are these dogs frequently removed for cleaning, and how many times are they replaced with sufficient care and skill to make sure that every part is in place and reasonably tight? Are all drop bolts on hatches and water-tight covers in place? Regardless of the condition of a rubber gasket, doors will not be remotely tight unless the knife edge is both clean and true. The easiest way to clean a knife edge is to use emery cloth, the coarser the quicker, but the result is usually a wavy edge after a short time. Frequent chalk tests on doors selected at random will indicate this condition. The knife edge is rubbed with chalk, and the door closed and dogs set up by hand as it would be in an emergency or regular use. On opening, the chalk transfer on the rubber gives a rough check on the efficiency of the door. And it frequently tells an interesting story.

The regulations prohibit the use of pneumatic scaling hammers on light plating, either bulkheads or shell. Even where the plating is relatively heavy, the tightness of the riveting is not improved by the careless use of the gun. Scaling hammers should be as light as possible, and should not be held at right angles to the work. The paint can be removed by this very common method, but only at the expense of the bulkhead. Blows squarely placed on the center of a rivet point will loosen the best-driven rivet. The best rule is to scale as infrequently as possible, and by training and rigid inspection, to insure that it is done properly.

Although the foregoing faults may cause extensive leakage and in the aggregate destroy water-tightness entirely, much more serious are the openings left by the removal of pipe lines, change in the lead of cables or in the location of riveted or bolted clips, racks, and miscellaneous fittings. Frequently such changes are made by the ship's force, leaving an opening which requires a riveted or welded patch plate. Until small welding outfits are part of our equipage, permanent repairs are beyond the capacity of the ship in many cases, but such an opening can be made practically water-tight by a well bolted patch plate, with a good canvas gasket soaked in thick red lead, and a grommet and washer under each nut. A piece of plate, bolted up without these precautions, will look just as well under a number of coats of paint, but it will not hold water. Holes left by old cable leads, or removal of bolts or rivets, can be effectually if not neatly closed by a bolt of proper size, two washers and the ever-necessary grommet, soaked in paint. With regard to electric cables, the screw holes at old clip locations must not be forgotten. The only satisfactory method is to cut the screw off flush, and peen it on both sides of the bulkhead.

The danger involved in leaving off bolted and portable plates provided for access, or removal of large or cumbersome pieces of machinery or equipment, while at sea, is so obvious as to require no elaboration. Yet it has been known to happen, leaving openings several square feet in area in bulkheads bounding large and important spaces. Not so evident is the lack of closing plates at points where light ventilation ducts pierce W. T. bulkheads. A sliding or portable section

is provided in the duct in such cases, which appears to close the duct effectually. It is not designed or intended to withstand water pressure, however, and the closure plate, or other device, should be secured in place near at hand and ready for instant use. Moreover, the sliding or portable part must not be gummed with paint, but must work freely.

When alterations are made by a navy yard, permanent repairs are presumed to be made, and the compartments air tested if any work, new or old, penetrated the boundary. With one eye on the cost, and the other cocked at the completion date, this last precaution may be omitted. The ship personnel are well within their rights and are, in fact, only performing their necessary duty as an inspection force, when they insist that the job be properly completed and water-tightness made as certain as in the case of a new ship. On the other hand, in writing job orders, compartment testing instructions should form part of every job affecting water-tight integrity.

A careful surface inspection will locate the worst and most serious defects. But after all visible openings are found and corrected there are apt to be enough leaks remaining to render the bulkhead almost useless as a water-tight structure. These can be found only by filling the tank or compartment with some fluid, under sufficient pressure to force it through the leak into an adjoining compartment, thus indicating its presence and nature. The use of water is prohibited in most cases by the contents or nature of the space; furthermore it involves much time, is difficult to remove, and if the bulkheads are in poor shape, it is difficult to control until tightness is attained. For tightness testing, air is the easiest and best means to use, the leaks being located with soapy water or a candle flame, and a final check on tightness being obtained by noting the loss in pressure after the supply is cut off.

In order that the water-tight integrity of naval ships will be maintained, air pressure tests at intervals not greater than one year are now required. On battleships, cruisers, and submarines, these are to be performed by the ship's force, the ship being supplied with compartment air-testing apparatus. To further facilitate these tests, new ships are equipped with fittings on doors, hatches, or manholes, to which the air hose and gauge may be quickly attached, eliminating the necessity of drilling and plugging test holes. Installation of these fittings is also in the modernization programs of older ships. Chapter 12, of the *Bureau of Construction and Repair Manual,* gives in detail the requirements of these periodical tests, the pressures to be used, and the methods of performing the tests. If completely and thoroughly carried out, they impose a large amount of work on the ship's repair party. On a new 10,000-ton cruiser, for example, some 187 compartments are tested for tightness in the course of construction. Of this number, tanks and fuel-oil spaces in use, boiler- and engine-rooms, and certain other spaces, are excepted from test, leaving approximately one hundred spaces to be tested every twelve months. This is no small task for the party on a cruiser, and if bulkheads are permitted to get into bad shape, may well be hopeless. Due to gunfire and the normal working of the ship in service, the degree of tightness required of a new ship can scarcely be obtained, nor is it required. The fall of pressure must be reasonably close to that of the last previous satisfactory test, or, where data is missing, and in any case, not greater than 10 per cent of the initial gauge pressure in ten minutes. In the new ship building, this would be considered very high, and the requirements are much more severe in order that the ship may get a fair start in its service life. In a storeroom of average size, well below the water line, tested at a pressure of five pounds gauge, a 10 per cent drop in ten minutes represents an equivalent total aperture of but 0.04 square inches. Not many leaks can be overlooked and permit the drop to remain less than this figure. A general rule cannot be followed in all cases, of course, particularly in small compartments where a very small leak will occasion a large drop of pressure. In such cases, the allowable drop should be calculated, following the simple method demonstrated in the pamphlet on air testing referred to before. The importance of this work must be emphasized, and a definite program laid out and adhered to, for, if this is done, and close attention paid to all changes and need for repair, testing becomes a much easier, routine job.

No reference has been made to gas-tightness, not because of lack of importance, but because it is very nearly synonymous with water-tightness. Since the gas will not be under pressure ordinarily, except possibly

due to wind, or in ventilation systems, tightness against gas is more easily secured. It behooves the first lieutenant, however, to look into the condition of the lighter bulkheads above the water line and the closed-in, and supposedly gas-tight, portions of the superstructure.

The official publications referred to in the course of this article contain all the information needed by the first lieutenant and his assistants. It is desired here to put down, in brief form, only certain points that seem to the writer to be of greatest importance.

(1) Close openings due to changes and alterations at the time the change is made, and see that it is properly done before painting.

(2) Inspect as carefully and frequently for holes and other visible leaks, as for dirt and poor paint.

(3) See that dogs, drop bolts, and other water-tight fittings are never removed for polishing. It can be done in place.

(4) See that rubber gaskets are not only free of paint but are live, and that knife edges are not only clean, but also true.

(5) Use scaling hammers only to remove rust, and paint that is blistered and dead, and then use with care.

(6) Lay out a program of tests and carry it out, keeping the test gang clear of other work if possible.

(7) Make sure that the proper pressure is being used. Too little will not show leaky glands and fittings, and the test will be misleading. Too much pressure may cause extensive damage, and be highly dangerous. In case of doubt, consult the bureau.

(8) Never use a spring gauge. A mercury manometer is provided with all test outfits, is sensitive, reliable, and nearly foolproof.

(9) Give the same attention to the water-tightness of bulkheads and decks that is demanded by the shell, fuel, and water tanks.

(10) Make sure that all closing devices, plates or valves on piping, air escapes, ventilation ducts and so forth, are always in place and workable.

A prominent professor of naval architecture, whose technical training is supplemented by years in a shipyard from apprentice to superintendent, once made the remark, "The more you learn about ships the less inclined you are to go to sea in one." This has some basis of truth, perhaps, but certainly the more you know about the tightness of your ship, the better you will feel when an emergency arises. The designer did his job when he laid out the subdivision and designed the structure according to the best practice; the shipbuilder did his when he followed those plans, and made the ship sound and tight; it remains the duty of the forces afloat to keep the ship in that condition.

A STANDARDIZED NAVIGATOR'S WORKBOOK

By Lieutenant William A. Mason, U. S. Navy

THE *Navy Regulations,* article 1015, require that the navigator shall keep a book in which shall appear all original observations and computations, made for the purpose of navigating the ship, or copy thereof, with results and dates. No book is provided or even suggested for this purpose and in consequence we find a different system in vogue on every vessel.

Some navigators prefer to use a rubber stamp for their sight forms. These stamps are unwieldy and it is difficult to stamp clear impressions of the necessarily lengthy forms. Others prefer printed forms which may be filed separately from the navigator's notes. The disadvantages of this idea are obvious. The sights do not accompany the usual navigational data of which they are a part and difficulty is experienced in binding and filing such forms. Often the printed forms are found pasted in the notebook. This makes a sloppy job at the best.

Now that modern navigational methods tend to reduce the computation of observations of heavenly bodies to one or two standardized forms (*H.O. No. 208* and the meridian altitude), it appears that the navigator's workbook might also be so standardized. Even though this were done, it would still be necessary to write down the sight form for each observation. This is an unnecessary step and one which can be easily avoided.

Utilizing an idea proposed some time ago by Lieutenant Commander Weems, that of the vertical sight form, the writer has devised a celluloid strip on which the formula for observation by *H.O. No. 208* is engraved. This strip is 13 11/16 inches long, 1 11/16 inches wide, and 1/16 inch thick.

The distance between the various steps of the engraved formula is so spaced as to coincide with the ruled lines on the standard blank ledger pages. A metal clip is affixed to each end of this celluloid strip by which it may be securely held in place in the ledger and at the same time be slid across the page. The width of the strip was chosen so that it might be used as a ruler to divide the page into five vertical sections in each of which may be entered all the necessary data for working out an observation by the method described in *H.O. No. 208.*

The time portion of the engraved formula is designed to permit the computation of the G.H.A. of any body—sun, star, planet, or moon. Duplication has been entirely avoided in the various steps of the computation, without having recourse to working uphill.

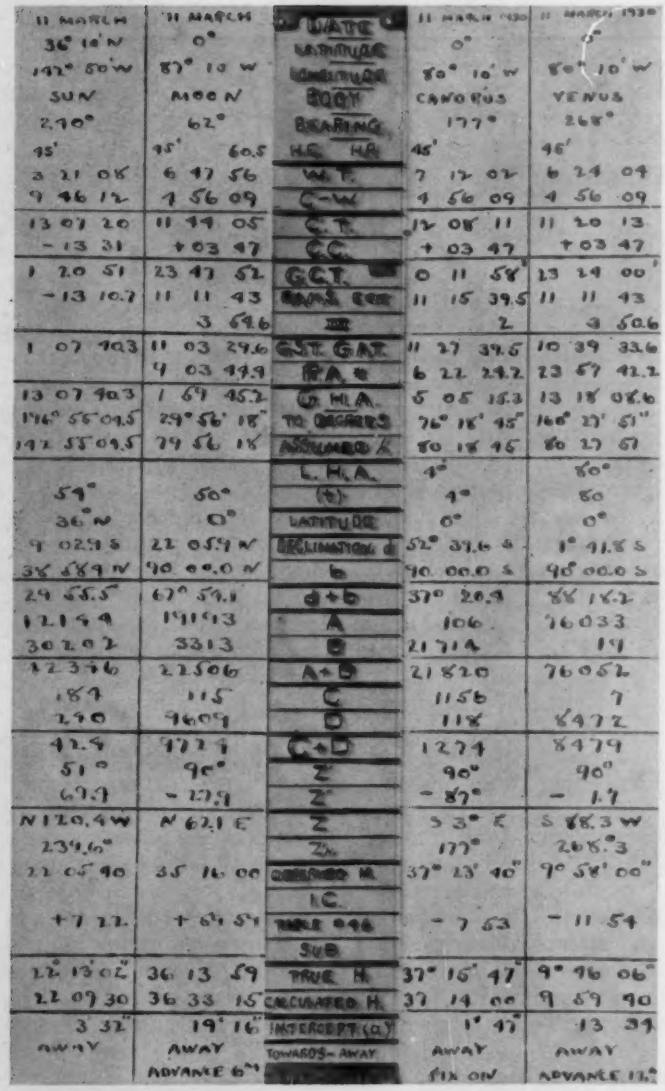
The standard ruled ledger has space for forty-three lines on each page on which to perform computations. It will be found that this allows sufficient space for entering all the necessary data, even the amount necessary to move lines of position when crossing two or more lines not observed simultaneously.

The construction and use of this device is clearly shown in the accompanying figure. The scale is shown in place in the ledger with four sample observations entered in their proper spaces. As each observation is finished the strip is slid to the next vacant column.

Although not so shown in the figure, the four factors, *latitude, assumed* λ *intercept,* and *Zn* (which are required for plotting the results of the observation) are outlined in red in order that the eye may more readily detect them when plotting. The balance of the factors are outlined in black.

The advantages of using a vertical formula and sight form have been previously commented upon. Briefly they are as follows:

The sight form data are recorded in a handy compact manner and in this form they remain as a permanent record.



Strip in place on right-hand page of a Navy standard ledger. Sample observations of the sun, moon, planet, and star are indicated to show the adaptability of this device. The clips, visible at the top and bottom, allow the strip to be slid from column to column. The first observation is entered in left column and the balance in succeeding columns to the right. Heavy horizontal lines are drawn across the page to indicate steps of the work.

In plotting the results of several observations taken simultaneously or nearly so, the data are all recorded on one sheet and the necessary plotting data are always found on the same lines.

The various astronomical data with their comparatively small hourly changes are always recorded on the same lines. If material errors have been made they can be readily detected by glancing back along the line to the data recorded in the previous sights. In some cases the values such as C-W, C.C., latitude, and R.A.M.S. may be copied directly from the previous observation without looking them up again.

The advantages of using the celluloid strip with the vertical formula engraved on it are:

A standard blank ruled ledger is used which may be obtained from any G.S.K. storeroom (standard stock catalogue No. 53-B-20).

The celluloid strip makes an excellent bookmark and due to the metal clips, it will not become displaced by the most violent rolling. This feature makes its use particularly desirable on small vessels such as submarines and mine sweepers.

With the ledger lying open, the right-hand page is divided vertically into five sections and is used for the computation of observations by *H.O. No. 208* as indicated here. The left-hand page is used to record the navigator's notes and other necessary navigational data such as departure, change of speed or course, etc.

It is thought that, inasmuch as the method of *H.O. No. 208* has come into almost universal use, the use of this formula might well be standardized in the manner described above.

It is realized that the adoption of this device for the computation and recording of lines of position would still require that certain other computations be necessary in the course of the day's work. Such computations as meridian altitude, interval to noon, ex-meridian, latitude by Polaris, deviation of standard compass, and gyro error might be entered on the left-hand page of the ledger. Possibly another celluloid strip might be devised which would cover all these operations.

Courtesy Lieutenant Henry Hartley, U. S. Navy

U.S.S. *S-51* APPROACHING HELL GATE BRIDGE, NEW YORK, DURING THE PASSAGE FROM POINT OF SINKING TO NAVY YARD, NEW YORK

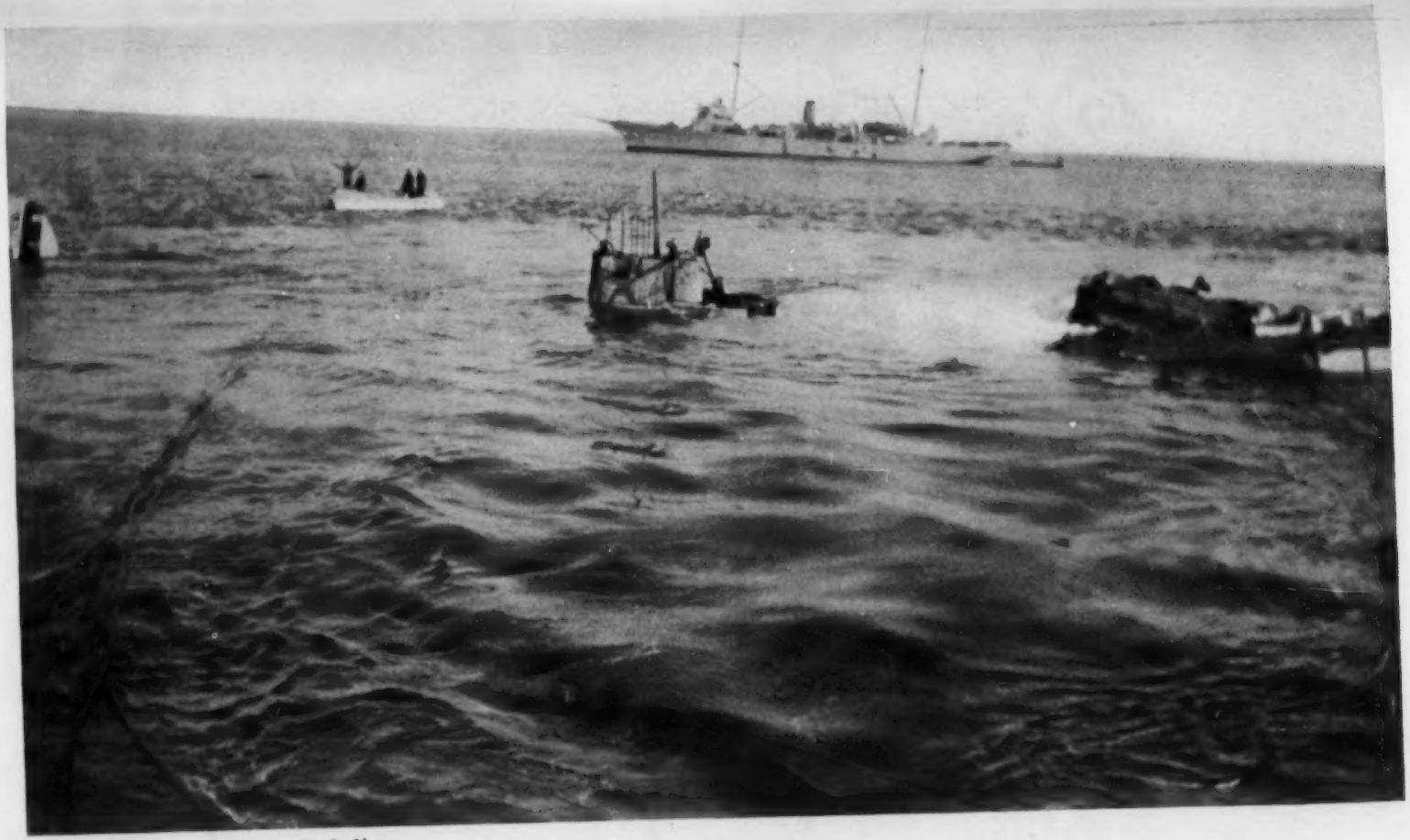
Courtesy Lieutenant Henry Hartley, U. S. Navy

STERN PAIR PONTOONS U.S.S. *S-4* SHOWING HOW AIR HOSE WAS LASHED UP, LED ACROSS A LARGE YOKE FITTED ON THE BOW OF THE *FALCON*, TRICED UP CLEAR OF THE DECKS

The air manifold is on the gun platform just abaft of the mast.

STERN PAIR PONTOONS U.S.S. *S-4* SHOWING HOW AIR HOSE WAS LASHED UP, LED ACROSS A LARGE YOKE FITTED ON THE BOW OF THE *FALCON*, TRICED UP CLEAR OF THE DECKS

The air manifold is on the gun platform just abaft of the mast.



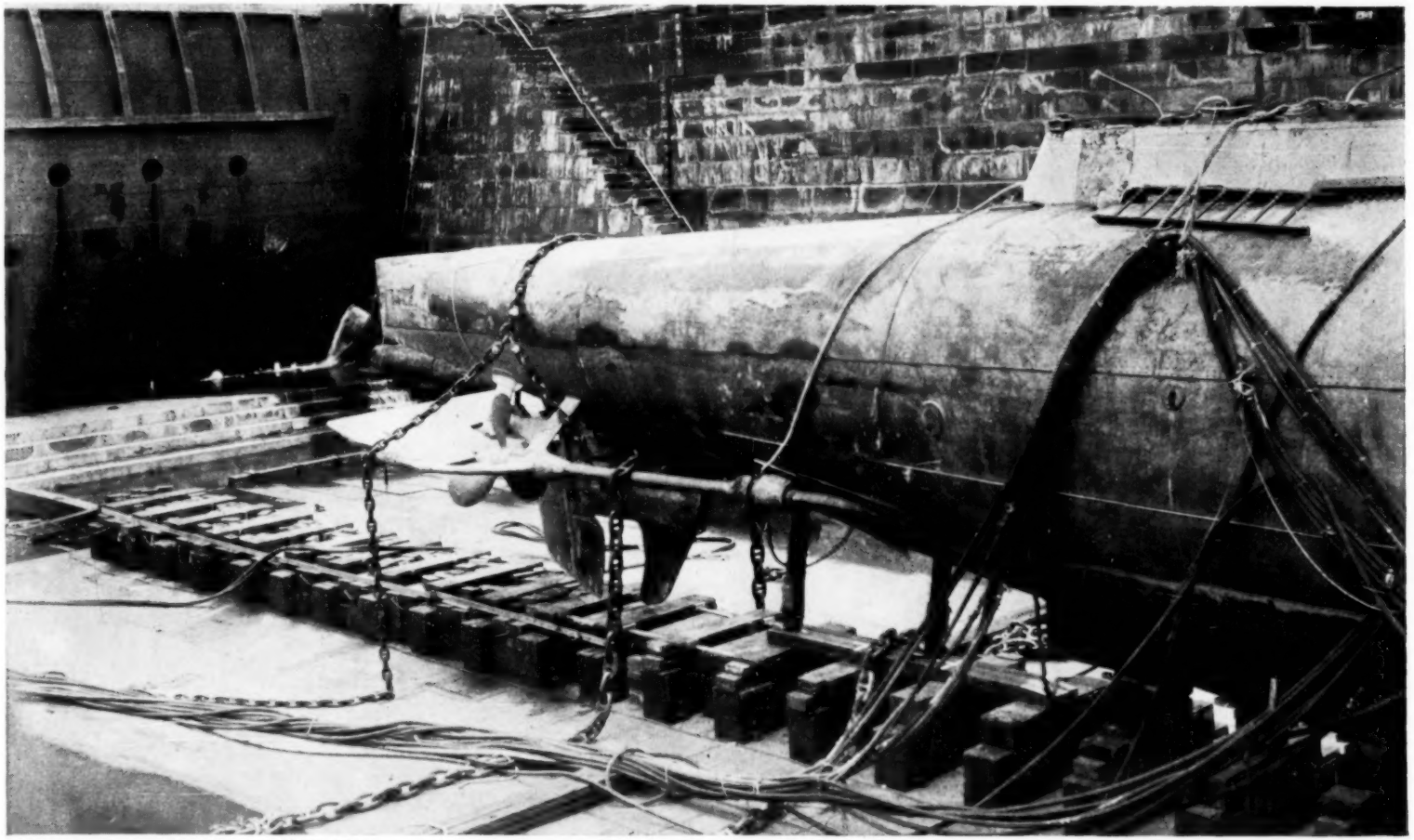
Courtesy Lieutenant Henry Hartley, U. S. Navy

U.S.S. *S-4* "UP"

Courtesy Lieutenant Henry Hartley, U. S. Navy

THIS PHOTOGRAPH SHOWS BURNING PERFORMED BY DIVERS ON THE *S-4*, DEPTH 114 FEET
Note the accuracy in locating and following the hull framing.

Note the accuracy in locating and following the hull framing.

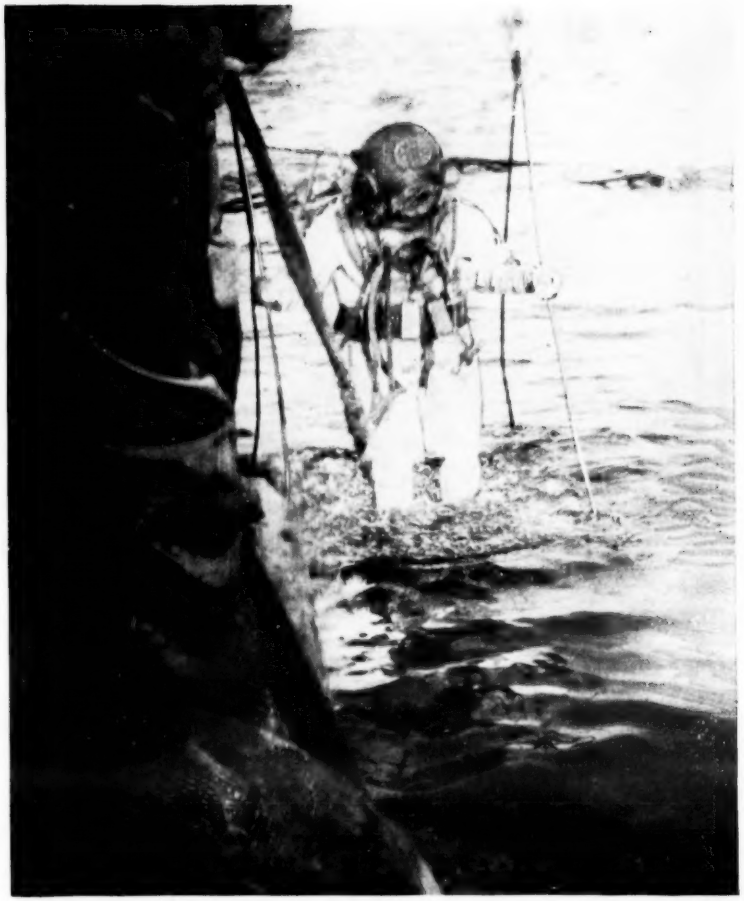


Courtesy Lieutenant Henry Hartley, U. S. Navy

U.S.S. *S-4* IN DRY DOCK SHOWING STERN BRIDLE OF 1½-INCH CHAIN PLACED WHILE THE SUBMARINE WAS AT A DEPTH OF 114 FEET
Note the air hose that was attached to the hull.

Courtesy Lieutenant Henry Hartley, U. S. Navy

DIVER BEING LOWERED INTO THE WATER ON THE STAGE



HOISTING THE DIVER OVER THE RAIL

Courtesy Lieutenant Henry Hartley, U. S. Navy

HERE COMES THE STERN, RAISING *S-4*

STERN PONTOONS HAVE JUST BROKEN SURFACE, *S-4*

U.S.S. *S-4* ENTERING DRY DOCK, NAVY YARD, BOSTON

Courtesy Lieutenant Henry Hartley, U. S. Navy

SOME HISTORICAL FACTS ON DIVING

By Lieutenant Henry Hartley, U. S. Navy

IT IS rash to say that anything is impossible, but physical and physiological knowledge alike point to the impossibility of man ever being able to descend to the floor of the ocean, without regard to depth, unless he be hermetically sealed within a metal structure sufficiently strong to withstand the pressure. He would then be no wiser, and certainly could not accomplish anything.

Men have been diving to the bottom of the seas from the earliest times, engaged in the recovery of lost treasures, and in the search for the riches that nature has reposed upon the floor of the ocean, such as sponges, pearls, valuable shell, etc. Starting with the naked diver, these activities have continued on through the centuries, and it is quite surprising to realize how little progress has been made. Only in comparatively recent years have we been able to send divers to a depth greater than one hundred feet with safety. The naked divers employed principally in the sponge and pearl fisheries were trained from childhood, and by the constant practice of inflating the lungs to their fullest capacity with air, no doubt greatly strengthened and somewhat expanded these organs above that found in the average man. We hear stories from time to time of pearl-fishers going to depths beyond one hundred feet, but these are probably myths. We do know that the naked diver, searching for sponges and pearls in warm localities, dives to a depth of sixty to seventy feet. The depths to which it is possible to go are limited by the time it takes to get to the bottom and back. The divers shorten the time of descent by holding on to a line made fast to large stones. Sponge fishermen in certain localities have employed a wicker basket to assist the diver down, by placing stones in the basket and holding it just under the surface with a rope, the diver seating himself astride the basket bale with the rope passing up between his legs. He then inflates his lungs, sometimes placing a horn clip on his nose; when ready his co-workers slack off the rope rapidly. When on bottom the basket serves as a receptacle for his finds. The diver is hauled back to the surface by the rope and basket.

The time that the naked diver is able to remain on the bottom is, like the depth to which he can descend, often greatly exaggerated. It is not possible for man to cease breathing for periods exceeding two to three minutes. Haldane, the English physiologist, states that the period during which the naked diver can stay under water depends on his power to withstand the excitatory effects of the carbon dioxide and other acids in the blood, the increasing concentration of which impels the respiratory center to such a state of exaltation that finally it can no longer be inhibited by voluntary effort. It therefore must require much practice, and a nice judgment on the part of the diver, to so time his stay on the bottom, allowing for the time required for the ascent, to permit reaching the surface within the limits of his ability to control the breathing organs.

Other physiologists have demonstrated that the respiratory center is excited more or less by the relative concentration of acid (the hydrogen ion) in the blood. In conditions where there is a want of oxygen, the oxidative processes in the tissues do not proceed wholly to the end-product, water and carbon dioxide, and half-way products accumulate, such as lactic acid. The naked diver suffers not only from the rising concentration of the carbon dioxide in the blood, but from the falling concentration of oxygen, for this leads to the increased formation of lactic acid in the muscles, and its appearance in the blood. The air in the mouth, nose, ears, and lungs is compressed during descent, and as the pressure equals four atmospheres at a depth of ninety-nine

feet, the air within the body will have been reduced to one-fourth of its volume. Owing to the rigidity of the walls of the nose and ear cavities, the full reduction in volume and corresponding equalization of pressures within and without may not take place; if this is so, the pressure of the air will be less than the pressure of the water on the rest of the body, and a cupping effect must take place. The ears are connected with the throat by the eustachian tubes—if this and the way to the nasal cavities are freely open, the pressure will equalize, and no cupping effect will occur. During the stay on the bottom, some of the nitrogen and oxygen of the air contained in the lungs must pass into solution in the blood and be carried to the tissue fluids. On rapid return to the surface, there takes place an expansion of the air which has been thus diminished in volume. The naked diver must fill his lungs well before diving to prevent the over-displacement of his heart by the ascent of the diaphragm, and so time his stay beneath the surface that the asphyxial congestion of the blood vessels is not brought to the rupture point.

In the whale, sounding to a depth of two hundred fathoms or more, we have an unsolved problem—what happens to the air in the lungs? Do the parts allow for full compressive action to take place? Is the air dissolved into the blood in proportion to the partial pressure? If so, what happens when the whale returns to the surface? Nature teaches the lower animal certain laws beyond the ken of man. Does the whale decompress himself? That is, does he stop at certain levels in his ascent? From the above it can readily be seen that the stories we sometimes hear to the effect that naked divers searching for sponges and pearls in tropical regions remain under the surface for periods of several minutes and upwards, are nothing short of myths.

As to the evolution of the diving bell and dress, Leonard Hill in his treatise on caisson sickness, says, "Such bell-like vessels are chronicled by Aristotle and Arianus as being a part of the warlike equipment of Alexander the Great, and as being employed for loosening of anchors and cables. In the time of Emperor Constantine, it is recorded by Xiphilinus that divers fitted with bells covering their heads carried Grecian 'fire' into the enemy's fleet. Julius Caesar describes a diving apparatus made of leather, and varnished to keep out the water." In the Middle Ages we find man using the diving bell. In 1538 two Greek divers gave an exhibition of being lowered into the Tagus sitting in a diving bell with lighted torches, which were still burning when they returned to the surface. An English diver, using a diving bell in 1665, is said to have recovered treasure from a Spanish ship sunk off Mull in 1580. John Christ Sturmins, a professor at Altdorf, 1695, constructed a diving bell of wood weighted at its lower edge and reënforced with iron hoops. The diver sat on a bench in the middle of the bell and signaled to the surface by means of a rope. He suggested taking down bottles of air to restore the air in the bell. This is probably the first serious consideration given to the application of air to the diver from an artificial source. It was observed and recorded at this time that while one man could endure two hours' breathing in the bell, another could stay but one hour, and the conclusion was rightly drawn that some factor other than the compression of the air came into play.

Modern science explains this individual peculiarity by the varying carbon dioxide production and oxygen used in lean or fat, quick- or slow-working men, as well as the varying power to resist the rising partial pressure of carbon dioxide and the falling partial pressure of oxygen in the bell.

In 1670 Robert Boyle, an English scientist, published researches made with the air pump contrived by himself; this was the beginning of the application of air for breathing purposes produced from an artificial source, and led to considerable experimental work by such men as Boyle, Mayow, Bert, and many others, seeking light on respiration and the effect of the various gases in the atmosphere upon respiration. This gave rise to the study of the effects of air above normal atmospheric pressure, and the study of caisson illness. F. Hoppe Seyler, in 1857, was the first to give a correct explanation of caisson illness. Thus it is seen that considerable information was known regarding the effect of compressed air on the human body before man brought forth the diving dress. Many ingenious and cumbersome kinds of diving apparatus had been tried when, in 1819, Siebe invented his "open" dress. This consisted of a metal helmet and shoulder plate attached to a water-tight

jacket, under which was worn a combination suit reaching to the arm pits. The helmet was fitted with an inlet valve, to which a flexible tube was attached. This tube was connected with an air force pump; the air kept the water from rising in the jacket. This arrangement was in fact, about equal to the present-day shallow-water diving (helmet) set, and necessitated the diver maintaining an upright position. If he stumbled and fell, the water filled his helmet, and the diver was in grave danger of drowning. After several years' experiments Siebe overcame the defects of the "open" dress, and brought out the "closed" dress (1837), the principle of which has since been in general use. As a diver enters the water, the superfluous air in his dress is driven out through the outlet valve by the pressure of the water on his legs and body. The water seems to grip him all around; if the exhaust valve of the helmet is screwed up tight, the dress will remain inflated and the diver will be unable to get down. If the valve is wide open, he will feel his breathing rather laborious by the time he gets his exhaust valve just under water, the reason of this being that the pressure in his lungs is that of the water at the valve outlet, whereas the pressure on his chest and abdomen is greater by something like two feet, or roughly a difference in pressure of one pound per square inch of surface exposed; to overcome this, a light spiral spring was placed on the exhaust valve stem operating against pressure from the inside.

The position of the exhaust valve on the helmet was obtained by the trial-and-error method; with the valve at the top of the helmet, breathing was just possible, but laborious; with the valve below the helmet, or in the breast plate, the helmet was lifted, and so much air accumulated that the diver could not remain on the bottom. The mean of these two extremes was sought, and the valve so placed that when the dress was properly inflated, the helmet and breastplate would just lift off the shoulders, supporting the weight of the belt, by means of the straps crossing the shoulders, suspender-fashion. It is therefore necessary for the diver to so adjust his exhaust valve that the pressure within is always slightly greater than that without. It is absolutely necessary that this should be so, otherwise his breathing would stop. But little change has taken place in the diving dress since Siebe brought out the "closed" dress. Those in use today are practically the same as those in use twenty-five years ago; then, as now, the dress consisted of vulcanized rubber between cotton twill, reënforced at the points of wear by chafing patches. The neck of the dress is fitted with a rubber collar through which the holes are punched for the studs of the breastplate. A portion of cloth, called the bib, is also secured inside the neck of the dress. The breastplate fits between the collar and bib, the latter coming well up inside the neck piece of the breastplate and serving to catch any water that nay come into the helmet through the valves. Elastic rubber cuffs are attached to the sleeves of the dress for making a watertight joint at the wrist, leaving the hands exposed. For cold-weather work, a rubber mitten was attached to the sleeve of the dress by means of a pair of metal rings and clamps. After the *F-4* operation, a new style of glove was adopted, which laced to the sleeves of an underjacket or vest that was worn under the dress, the joint depending on the elasticity of the cuff, and wide bands of thin rubber (snappers) for its water-tightness; this arrangement was not satisfactory. Flaps with lacings were fitted to the rear side of the legs, and so arranged that they permit lacing the legs up tight, to prevent the accumulation of air in the lower portion of the suit; this was a very valuable addition, as it not only lessens the danger of blowing up, but also prevents the diver from capsizing, decreasing the chances of drowning the diver in case of blowing up.

During the *S-51* operation a new type of molded three-stall glove with stockenet-cloth gauntlet was devised; this glove was cemented direct to the sleeve of the dress in lieu of the cuff, and gave excellent results.

The helmet and breastplate, made of tinned copper, have undergone several changes during the past twenty-five years, principally in changing the manner of securing to the collar of the breastplate, from the four-lug swing-bolt style, to the interrupted-screw thread; the faceplate, from the screw type, to hinge type; the same exhaust valve is in use now as then but it has been placed more accessible to the diver's reach, and the helmet has been somewhat enlarged, so that it now has about two-thirds of a cubic foot capacity. The most important

change in the helmet is the installation of a telephone transmitter, and jack plug for the receiving microphones which the diver wears fitting over his ears. These are held in place by means of a skull cap. Much difficulty has been experienced with the telephone due to dampness and air noises. The diver must shut off his air and close his exhaust valve in order to hear over the telephone, and even then it is difficult for him to understand other than words spoken very clearly, slowly, and distinctly; to receive messages from the diver is even more difficult because of the peculiar effect that compressed air has upon the voice, changing both its timber and volume. The diver breathes rapidly and consequently must talk rapidly. However, the phone is of tremendous value even now, and perhaps in time its acoustical properties can be improved. During the salvage operations on the *S-4* a new type of batteryless telephone was used, and while its acoustical properties were somewhat weaker than the battery phone, its freedom from the effects of moisture more than compensated for this difference. However, in due time this phone gave considerable trouble because of broken wires.

The belt and shoes remain the same as were in use twenty-five years ago except that a jock strap has been added to the belt, which serves to keep the helmet and breastplate from lifting too high. The old diving lamp has been discarded for the new 1,000-watt light manufactured by the Western Electric Company, and developed during the salvage operations of the *S-51*. This new light is a very valuable asset for working at night or inside hulls. The most important stride that has been made during the past quarter century in furthering diving is the substitution of high-pressure compressed air carried in special containers or torpedo air flasks, and using of power-driven compressors for furnishing the diver air supply. The amount of air that could be furnished by the hand power pump restricted diving to depths of about eighty feet. Using high-pressure air from accumulators, reducing valves or expansion tanks must be used in order to lower the pressure in the diver's hose to something below 150 pounds. When using power-driven compressors, the governors on the compressor are set to throttle at a pressure of 150 pounds, the compressors delivering air to a storage or volume tank from which it passes through permanently installed piping to the place where the diver's air hose is connected. Using air other than that furnished by the hand pump, the length of air hose connecting to the diver's non-return valve at the back of the helmet is but three feet, passing under the left arm pit and connecting to a specially constructed valve, called the control valve, which in turn is secured to the lower left stud on the breastplate, by means of a loose link. The handle of this valve comes at the point where the left hand would rest if the arm were folded in toward the left breast. To the other side of this control valve is connected the diver's air hose leading to the surface. The diving regulations require that the diver have a sufficient supply of air to permit him to carry at his control valve at least thirty pounds in excess of bottom pressure. In this way the diver controls his own air supply.

The next item of importance to be added during the past quarter century to broaden the art of diving is the system that was installed on board the U.S.S. *Falcon* during the salvage operations of the *S-4*, which permitted controlling the moisture and temperature of the compressed air supplied to the divers through mechanical process. This permitted carrying on diving operations in air temperatures as low as eight degrees Fahrenheit and water temperatures as low as thirty-one degrees Fahrenheit. Next in importance is the knowledge that has been gained on the physics of diving. These three last-mentioned items now permit us to send divers into deep water with comparative safety, regardless of temperatures. The present-day diving dress weighs 27 pounds; the helmet and breastplate 53 pounds; the belt 80 pounds; shoes 28 pounds; totaling 188 pounds. To the diver's working implements we have added air-driven tools, the electric-arc burning torch, and the hydrogen-oxygen burning torch.

Twenty-five years ago the diver climbed over the side of a launch and hung on to a ladder, the attendants helping him, lifting his legs over the gunwale, being careful not to allow the heavy shoe to fall and possibly crack the shin bone like a pipe stem. His helmet was bolted rigidly to the breastplate. The faceplate was off. His belt was placed and the straps buckled. One tender held the life line, a 2.5-inch cable-laid manila secured about the body under the arms; a sec-

ond tender held the air hose. The faceplate was *moistened with vinegar,* to prevent fogging, and screwed in place. The diver climbed down the ladder and slid down his descending line. Reaching the bottom, he gave one jerk on his life line, meaning "On the bottom." All communication from now until his return to the surface was carried on by pull signals on his air hose and life line, which were kept clear of each other as much as possible. If the diver needed more air, he gave one pull on his air hose; less air, two pulls; etc. The usual purpose of the dive was to search for lost objects in water up to about eighty feet (though his qualifying depth attained in the gunnery school was sixty feet) or he might be clearing a strainer or cleaning a propeller. Today the diver is dressed sitting on a small bench, near the point where the descending line coming up from the bottom plumbs; he wears a skull cap to support the microphones held over the ears by a chin strap; his helmet is held just above his head with the jack plugged in and he talks over the phone to his telephone tender. The telephone cable passes from its connection at the back of the helmet under the right arm and is made fast to a lug on the front part of the breastplate, and has sufficient strength to be used as the life line; to it is stopped the air hose forming one rope, the first one hundred feet being sewed up in canvas to minimize fouling. His faceplate butterfly nut has been set up tight and wired in place. The faceplate glass is *not* treated with vinegar to prevent fogging, as we have found that this fogging is the diver's first warning of carbon-dioxide accumulation.

At the word, "Phone O.K.," the helmet is lowered in place and given a twist to cause the interrupted-screw segment to engage; the safety bolt is dropped into its slot; the diver rises and steps on the stage, assisted by two dressers; he grasps the bales of the stage, and is hoisted by the winch clear of the rails. If the boom head has been properly placed, two hands can easily guide the stage clear as it is lowered. When the helmet is just under the surface, lowering ceases, and the diver adjusts his air valves, sees that his suit is tight, again tries his telephone, steps off the stage when told to go down. He is assisted to the descending line by his tender. On the descending line, he is often given his tool bag, water light, or other objects, slipping the eye of a short piece of 12- or 15-thread stuff attached to the object over the right arm; he locks his legs about the descending line, grasps it with the right hand, and with his left hand on his air control valve, slides down to his work. If he is to use power tools, they have been sent down ahead of him. Perhaps his working mates, one or more, have preceded him. On the bottom he controls his own air supply. He reports over the phone that he is on bottom, and quite often asks for and receives instructions over the phone; in fact, in spite of the difficulties met with in the telephone, it is indispensable as a time-saver in salvage work, and has on several occasions been the means whereby a diver's life was saved. During the salvaging of the *S-51* and *S-4* sketches were made of the submarine's air manifolds. With the sketch on a small board before them, two divers in the central operating compartment (one to hold the light) plotted the actual conditions of the manifolds as left by their crews; then again with divers at the manifold, and this sketch before the salvage officer, the diver could be directed in his work with accuracy. The diver was often coached and directed in his work among the highly complicated fittings inside the submarine. In the case of a diver becoming foul, not at all uncommon on a wreck job, the most information that the diver could transmit to the surface without the telephone would be the fact that he was foul (two pulls on hose or life line repeated); and if his lines were fouled between diver and surface, even this bare information could not be signaled.

Diving is not governed by physical ability to withstand external body pressure as is oftimes erroneously believed. One of the first things that a diver must learn is the proper adjustment of his exhaust valve, so that breathing is always quite free. Bleeding at the nose is quite common with inexperienced divers, and is due to not keeping the exhaust valve sufficiently closed, especially during exertion and inspiration, producing too great a cupping effect on the pulmonary blood vessels, because of the difference in pressure of the water between the exhaust valve and the area over the lungs. The exhaust-valve spring regulates the amount of air in the dress, and therefore the buoyancy of the diver. Breathing is easiest when the dress is full of air to the level of the abdomen, but when this is so, the diver runs a risk of being

blown up to the surface, and it is this fear that causes the inexperienced diver to open his exhaust valve too wide. With a properly inflated dress, the breastplate is just lifting the weight of the belt from the shoulders; however this must not be attained at the expense of ventilation. Fogging of the faceplate glass is the first indication of an insufficient flow of air through the helmet. Should the diver ignore or be ignorant of the cause, headache, with a tendency to drowsiness, will follow; when these conditions are met with on the bottom the diver should come up. Attempts to reach normalcy by resting may prove fatal from carbon-dioxide poisoning.

The first difficulty encountered by the diver is that in equalizing the air pressure on either side of the ear drum. This has usually been accomplished by the time he reaches 30 feet. At 33 feet the diver has increased his external pressure 100 per cent, that is, he has gone from 14.7 pounds to 29.4 pounds, and necessarily must have breathed air in excess of 29.4 pounds in order to build up internal pressure; at 66 feet he is at an absolute pressure of 44.1 pounds, or two atmospheres, but his ratio of pressure has changed from 33 feet, 29.4 pounds, to 66 feet, 44.1, or 50 per cent; from this depth on, pressure plays a less important part, as the ratio of change falls rapidly, as shown by the table below:

As to the diver in deep water, we are first concerned in maintaining him there, the retarding agent being, first, carbon-dioxide poisoning. The air we breathe contains .03 per cent carbon dioxide at surface. At nine atmosphere the diver's inspired air contains 0.27 per cent carbon dioxide; the normal expired air from the lungs contains about 4 per cent carbon dioxide; therefore we have the following: 0.03:4: :0.27: X = 36 per cent of volume of inspired oxygen, or $36 \times 20 \div 100 = 7.2$ per cent carbon dioxide that the diver breathes into his helmet at nine atmospheres excess pressure, or 10 atmospheres absolute. We are told that when inspired air contains 3 per cent carbon dioxide, breathing will be about doubled, and moderate work in such air will cause moderately hard breathing. I personally have a very clear memory of this effect of carbon dioxide. Six per cent carbon dioxide causes very great distress; 10 per cent brings about a tendency to unconsciousness. We cannot expect perfect ventilation of the helmet, especially when it is necessary for the diver to cut down his air supply in order to send or receive messages over the telephone. Thus it can be readily seen that at nine atmos-

Absolute pressure in atmospheres	Gauge reading excess pressure	Depth in feet	Per cent of change showing why a diver who can go to four atmospheres, and stand that pressure, can easily go deeper	Per cent of change from bottom (read up) showing why the diver can come up to four atmospheres to start decompression. The percentage of change approximately is 33.33 per cent*	Per cent increase per foot	CO^2 in inspired air in diver's helmet
			%	%	%	%
1	0	0		292.9†		.03
2	14.7	33	100	192.9	3	0.8
3	29.4	66	50	142.9	1.5	1.6
4	44.1	99	33.33	109.6	0.33	2.4
5	58.8	132	25	84.6	0.25	3.2
6	73.5	165	20	64.6	0.20	4.0
7	88.2	198	16.66	47.9	0.16	4.8
8	102.9	231	14.3	33.6	0.14	5.6
9	117.6	264	12.5	21.1		6.4
10	132.3	301	11.1	10.0		7.2
11	147.0	334	10			
Total increase.....			292.9			

† Total decrease.

* Safe decompression after a long exposure is half the absolute pressure i.e., the air breathed being one-half the pressure of the nitrogen in the blood. The ratio of change from four atmospheres out shows why time increases as pressure decreases.

pheres excess pressure the diver's stay on the bottom will be limited to from ten to twenty minutes at best. I have heard it claimed that tests have been made where men were subjected to pressures in excess of 300 feet with no ill effects. However, I believe these tests were made in a recompression chamber having a cubical capacity of about 600 feet whereas the diver's Mk V helmet has but 1078 cubic inches or roughly two-thirds of a cubic foot. Further, there is a very marked difference between the psychological conditions of the man sitting comfortable and inactive in the recompression chamber, and the man going into deep water in a diving dress. It is clearly obvious that this test can give no fair comparison of the effect of carbon dioxide on the diver, which is the first and most important item to be considered. Second in importance in retarding deep diving is the effect of oxygen breathed under pressures; and third is the rapid increase in the rate of saturation of the body tissues with nitrogen.

There is no appreciable danger of oxygen poisoning at nine atmospheres excess pressure as the body will only absorb the amount necessary to support life, but the partial pressure, or driving force of the oxygen breathed, appears to have a peculiar effect somewhat similar to an intoxicant, and referred to in the diving manual as oxygen exhilaration. A diver suffering from this cause is far from normal, and not capable of thinking clearly; it is very difficult for him to understand messages sent over the telephone; in fact, incidents have been experienced where a diver wandered off aimlessly, showing clearly that he did not know what he was doing. On one occasion it was necessary to pull the diver clear of the bottom; this occurred at a depth of 136 feet. When on the surface this diver admitted to me that he did not clearly remember. Numerous occasions occurred during the diving operations on the *S-51*, depth 136 feet, where the diver was carefully instructed in his task, and could clearly explain it in detail, but once on the bottom he appeared to have but a hazy idea of what he was supposed to do. We attributed these conditions to oxygen exhilaration, and found it necessary to select divers carefully for certain work, even though they appeared in all respects equal when not under pressure. The danger from oxygen exhilaration lies in the fact that the diver is not capable of recognizing his condition.

Oxygen breathed under pressure has an irritating effect on the lungs, the greater the partial pressure, the more marked this effect becomes; at above ten atmospheres, oxygen poisoning will take place. It is the exposure of the central nervous system to a high partial pressure of oxygen that causes convulsions; the solubility of oxygen in blood at body temperatures from an atmosphere of oxygen is about 2.4 per cent, so that at a pressure corresponding to two atmospheres of oxygen or ten atmospheres of air there would be 4.5 to 5 per cent oxygen simply dissolved in addition to the 20 per cent combined with the haemoglobin. All living things perish at a pressure of oxygen corresponding to twenty atmospheres of air. It is obvious that, as the human body's endurance and resistance against all elements varies greatly in each individual, in diving we must use those figures that will best fit the average. We know that oxygen pressure of two atmospheres is poison and will produce pneumonia in its most acute form, attended with convulsions. However, we have record of at least three Navy divers descending to a depth of ten atmospheres with one case of pneumonia as a result of this exposure. What we don't know at this time is how long we can expose the average diver to such pressure with safety. From the above causes, it is evident that the depth to which we can safely send the diver is limited.

The next problem is getting the diver back to surface without the liberation of nitrogen bubbles in dangerous quantity in the body tissue. Here we are dealing with a gas under pressure in contact with a fluid. The lungs become instantly saturated to the full extent with nitrogen at the existing partial pressure in the air. The blood passing through the lungs picks up this nitrogen; when this blood reaches the systemic capillaries, the nitrogen will diffuse out, and the blood will return for a fresh charge, this process being repeated until at length the tissues are fully charged. Those parts receiving less blood supply take longer to saturate; on the other hand they require more time to desaturate. There is considerable room for argument on the question of saturation, and in this all-important question lies the crux of the situation. Animal work has shown that a point is finally reached

when the body tissues will absorb less and less nitrogen, causing embolism and death while under pressure. Upon rapid decompression, causing death to the animal, large quantities of nitrogen were found in the blood, the heart, and stomach. Thus far experience teaches us that we may work a diver several hours at one atmosphere, and bring him direct to the surface without decompression, while for a period of ten minutes at 250 feet (7.6 atmospheres excess pressure) seventy-three minutes is required to decompress the diver. The pressure (depth) at which the diver begins to absorb nitrogen in dangerous quantities is somewhat in doubt, also the rate of increase due to increased pressure. Leonard Hill in his treatise on caisson illness states, "There will be roughly 1,000 CC of nitrogen dissolved in the body at one atmosphere, 2,000 CC at two atmospheres, and so on," but he does not state the period of time required for saturation to take place; it depends on the coefficient of solubility of the gas in the blood, the temperature of the blood, and the pressure of the gas.

Safe decompression, or safe desaturation, is that which will so decrease the pressure of the air breathed by the diver as to permit the nitrogen to come out of solution, but not to expand in such large bubbles that it cannot pass through the capillaries, and back out of the system, in the reverse order to that in which it entered. The longer the exposure, in relationship to depth (pressure), the greater the saturation, and consequently the longer it will take to desaturate, and the only safe rule is based on the principle "As depth (pressure) decreases, time must increase." Nothing has been brought forward that justifies any change from this principle, and any attempt to depart from these principles that have been tried have only resulted in getting the diver in trouble. The use of synthetic gases (helium) has been more or less experimented with since 1924, and has not given any satisfactory results.

In the experimental diving conducted by the Navy in 1914, the diving crew consisted of a few hand-picked men averaging about thirty years of age. They were experienced divers, had worked in pressures to 75 pounds (160 feet), and tank pressures to 120 pounds (270 feet). This work was in progress when the *F-4* sank, and this crew as a unit was sent to Honolulu, where they made eight dives to a depth of 306 feet. Duration of stay on the bottom was fifteen to twenty minutes. Diving conditions were ideal in this tropical region, the waters transparent and warm. One of the three divers who went to this depth became foul, his stay on the bottom was prolonged, and he suffered both caisson trouble and oxygen poisoning. Chief Gunner William F. Loughman, U. S. Navy, is the only remaining survivor in the Navy of that crew who conducted our first deep diving experimental work, and who descended to the record depth mentioned above.

Diving performed on the attempted salvage of the *S-5* extended over a period of two summers; seven regular divers were used, with the depth approximately 156 feet. The decompression tables contained in the *Bureau of Construction and Repair Manual* were used.

The diving on the steamer *Lakeland,* sunk in Lake Superior, was performed by Navy divers; depth of water 211 feet (93.9 pounds); duration on bottom fifteen to twenty minutes.

The diving performed during salvage operations of the U.S.S. *S-51* totaled 556 dives to a depth of 136 feet; the average time on bottom was set at one hour during the second period, that is, during the spring and summer of 1926. Tables approximating those of the diving manual were used, and only minor cases of the bends occurred.

During the salvaging of the *S-4,* 564 dives were made; the maximum depth at high water was 114 feet; decompression tables used were Bureau of Construction and Repair, lengthened out due to the very cold weather. About nine cases of minor bends occurred, but always in cases where the diver had been working hard over a period of one hour. This but serves to bear out the contention that "The present tables as laid down in the *Bureau of Construction and Repair Manual* may be lengthened, if at the shallower depths, i.e., from forty feet out, but they cannot be shortened with safety to the diver."

During the salvage operations of both *S-15* and *S-4,* we experienced no difficulty in having a sufficient number of divers whom we could send to those depths, but the number of divers who could go down and actually accomplish work was surprisingly small. About half of those available could only act

as assistants to the man actually doing the work. We have qualified divers by the hundreds in the Torpedo School at Newport, but not one of them was ever given a task to perform on the bottom requiring the use of tools; in fact the practice has been continued along the lines followed when I went through the Gunnery School—the time allotted to diving being just sufficient to give the students some practice at dressing, undressing, and tending the diver, and to make a few dives, walking about the bottom up to the qualifying depth, sixty feet, later advanced to ninety feet. When the depth was sixty feet, if the diver could stay down twenty to thirty minutes he was marked as a "qualified diver." Later the sixty-foot man was designated "diver second class," and the ninety-foot man "diver first class." Their ability to use tools underwater did not enter into the question, and to correct this condition the present curriculum for training divers at the Deep-Sea Diving School was formulated. The qualifying depth is set at 150 feet; after he has made the qualifying depth of 150 feet, and has been taught to use hand and power tools underwater, we then find out what pressures the individual can safely make, up to 300 feet, and mark his record accordingly. His proficiency in the use of tools determines whether he is rated diver second or first class. The outline of the course at the Deep-Sea Diving School is as follows: the men are selected from petty officers ratings, who have qualified elsewhere in the service as divers first or second class, and who volunteer for this special training. Before being assigned to the school, they are required to pass a special physical examination, and only those passing a high physical standard are chosen; they must be entirely free from diseases of the ears and nasal passages, heart, lungs, and kidneys, they must possess normal blood vessels and be of good muscular development. Moderately stout men and men of middle age are more disposed to caisson disease than young, slim, wiry men.

The best type for diving work is the thin, wiry man of a phlegmatic temperament, twenty to thirty years old.

The course of instruction covers a period of twenty-six weeks. The subjects covered are:

(1) Diving under pressure in a tank up to pressures equaling three hundred feet of sea water.

(2) Training in the use of hand and power tools underwater, including burning with the oxygen-hydrogen torch and the electric-oxygen torch.

(3) Diving from the diving boat; underwater seamanship; conducting a search of the bottom; making hose connections to a pontoon, bolting up pipe flanges; supervising diving, using both high and low pressure air.

(4) Use of recompression chamber for decompression and treatment of compressed-air illness.

(5) Burning and cutting metal in open air.

(6) Bench work; use of hand and power tools for drilling, tapping, caulking, cutting out rivets, pipe fittings.

(7) Instructions in care and operation of Navy standard rescue breathing apparatus.

(8) Repairs and maintenance work on diving gear; cutting holes in collar of dress, fitting cuffs, and gloves to dresses; vulcanizing; patching dresses; fitting couplings to air hose, overhaul and repair of diving pumps and helmets.

(9) Diving telephones—instruction in repair, upkeep, and maintenance.

(10) Study room instruction in tables, formulas, and methods of computing diver's air supply; calibration and test for efficiency of diving pumps; physics of diving, caisson disease, cause and treatment; a complete study of diving manual; notes on salvage and rescue work; use of pontoons, lowering, securing, and blowing.

(11) Keeping of logs; each man is required to keep a log which is examined weekly; he is furnished with mimeograph copies of tables and sketches relative to the above subjects and these mimeographs in addition to the logs furnish a ready reference work for men after they have completed the course.

(12) From time to time lectures by men who are especially well informed are given on various subjects pertaining to diving and salvage work.

OUR PETTY OFFICERS

By Commander John W. W. Cumming, U. S. Navy

COMPARATIVELY recently there have been issued instructions and requirements necessary in order to have placed upon the eligibility list in the Bureau of Navigation the names of enlisted men for advancement to chief petty officer.

The rating of chief petty officer is the highest rating of our enlisted personnel, and those who have earned this honor should represent the acme or cream of the enlisted personnel. They have been set apart, so to speak, by the Navy Department in that they have a separate mess afloat and ashore and have a distinctive uniform.

Chief petty officers are so rated, after due service, recommendation, and examination, from men of the lower ratings. It is the training and preparation of the man himself as to character, mental and physical ability, his sense and understanding, and proper performance of duty that are important before he ever becomes eligible for the rating. In this, the responsibility, it seems, would lie principally with the seniors under whom he serves prior to becoming a chief petty officer, and who recommend him, i.e., his divisional officer, his executive officer, and his commanding officer.

It is self-evident and usually true that the way one is trained in the formative period of his career establishes his conduct and sense of duty in later years. There may be exceptions, perhaps, to this as to other general rules.

However, it is necessary that men who are recognized as possible petty officer material should be trained and developed as much as possible prior to receiving their first rating, and continually trained during all the time of their advancement up to chief petty officers, and properly supervised while chief petty officers. The word properly has a vast range since all chief petty officers are not of the same caliber. The exercise of this supervision requires leadership and understanding of the men immediately under supervision.

It should be the ambition of every non-rated man in the Navy to become a petty officer, but he should be required to earn this by his ability and performance of duty. The worth-while, ambitious, non-rated man will, in due course of time, be selected for a petty officer rating, but, throughout all the ratings of petty officer, including chief petty officer, he should display the ambition to render the best service he is physically and mentally equipped to render.

Article 1275, *U. S. Navy Regulations, 1920,* sets forth in clear, concise terms the standard for a petty officer of all ratings and it is necessarily the responsibility and duty of those in charge of petty officers to take the steps necessary that this standard be maintained.

The fourth and last paragraph of this article reads, "When an enlisted man is appointed petty officer, the commanding officer shall bring to his attention the provisions of this article." Note that "shall" is used and not "will" nor "should."

In addition to this mandatory duty of the commanding officer, the manual of the Bureau of Navigation requires the following entry to be made in an enlisted man's record when he is appointed a petty officer: "(date); appointed (rate); article 1275 *U. S. Navy Regulations* read and appointment accepted. Authority (signature of the commanding officer)."

What, then, is this article 1275 upon which is laid so much stress and importance? Let us analyze it and get its purport.

Paragraph (1) reads as follows: "Petty officer shall show in themselves a good example of subordination, courage, zeal, sobriety, neatness and attention to duty."

Again we have shall and not should or ought to show. Show how? By teaching or talking? Not a bit of it, but show in themselves by being a living example. What sort of an example? A good example. A good example of what? Read the characteristics expected of a petty officer.

The last characteristic, attention to duty, more or less embodies the first five and every other characteristic possible.

A petty officer is a good example of subordination when he in thought, word, and act loyally, willingly, and gladly gives proper recognition and full coöperation to all proper authority. Measure yourself according to this honest standard of subordination. How many times have you reluctantly obeyed or criticized adversely proper authority? How many times in the presence of juniors have you been insubordinate in thought and action concerning proper authority to which you know you were not loyal? Would you want your juniors to do the same concerning you? You do not have to say or do something to be insubordinate. You can be insubordinate by a sneering expression on your face and thus immediately inform others just what your real attitude is. Remember a *good example* is wanted as to subordination.

As to courage, remember—always remember—there is *physical* courage and there is *moral* courage; both are important and necessary to become a petty officer. Moral courage involves stamina or strength of character. At times a petty officer may be in a situation that requires a display of moral courage and not of physical. This may occur when he is tempted to violate the trust and confidence reposed in him by doing something which he knows would set a bad example to his subordinates. Moreover, by lack of moral courage he may so compromise himself that he may lose the respect of his fellows, and ultimately be disrated. A petty officer must know when to say "No" and mean it, and when to say "Yes" and mean it. To be fair and square with everyone requires moral courage which will keep a petty officer from being carried away by the lure of a false popularity among his shipmates. It takes moral courage as well as possibly physical courage to set a good example of loyalty to duty when in an atmosphere or surroundings of disloyalty and insubordination. However, remember that it is a good example of courage that is wanted.

Consider zeal. A petty officer has zeal when he has an active interest in his duty and the command and displays enthusiasm or ardor in the pursuit of his desire to perform well his duty at all times. Can anyone really and truly be zealous in his duty if he is not loyal in thought, word, and action to that duty and to every policy of his divisional officer, of his commanding officer, of his commander in chief, and finally, of the Navy Department? Ask yourself this question concerning yourself and remember that a good example of zeal is wanted.

A petty officer cannot render in his duty 100 per cent efficiency if he is not sober. No petty officer, however slightly he may be under the influence of any drug or intoxicating liquor, unless administered by proper medical authority, could be called a good example of sobriety.

Neatness involves attention to one's physical appearance and carriage, cleanliness and fit of uniform, and the proper manner of wearing the required regulation type of uniform. Be a good example in neatness.

As to duty to be performed, find out definitely from the proper authority exactly what you are supposed to do, and then by thought, word, and action give your loyal, willing, and honest efforts to show in yourself a good example of attention to duty.

Now let us take up paragraph (2). It reads as follows: "They [petty officers] shall aid to the utmost of their ability in maintaining good order, discipline, and all that concerns the efficiency of the command."

Again we have the word "shall" in "they shall aid." How shall they aid? Halfheartedly? No! What is expected is "the utmost of their ability," the very best of what they are capable.

What shall they aid in to the utmost of their ability? First comes good order, which needs no explanation. The second, discipline, needs little if any explanation. If a petty officer is really the good example required in paragraph (1) discussed above, much of the good order and discipline will be taken care of by his good example and perhaps many infractions or offenses may thus be prevented. The influence of a petty officer upon the crew is good or bad depending upon whether the petty officer is a good example or a bad example.

Good order and discipline are necessary in every organization or institution of our government, if such organization or institution is to function for any good purpose for which it was established. The lack of good order and discipline means chaos.

The latter part of paragraph (2) is most important in its scope in that it deals with "all that concerns the efficiency of the command." What shall petty officers do in this connection? They shall aid to the utmost of their ability in maintaining all that concerns the efficiency of the command.

Don't forget "shall aid" and "to the utmost of their ability" which have been previously pointed out. The next words are comprehensive "in maintaining *all*," not a part, but "all." All what? All that concerns or has to do with the efficiency of the command. Anything bad or improper certainly will not add to the efficiency of a command, and anything that does not add to the efficiency is bound to detract from or lessen that efficiency. It naturally follows that it is a petty officer's duty to aid to the utmost of his ability the suppression of everything that lessens the efficiency of the command, and to aid to the utmost of his ability the advancement of everything that increases the efficiency of the command, since that is the only way that efficiency can be maintained.

What is the first thing any petty officer must do before he can really aid in maintaining the efficiency of the command? The first thing for him to do is to examine himself and see that he, himself, complies with the very first paragraph of article 1275. Read it again and see just wherein he is to set a good example. He who is to have authority over others must first learn to obey promptly and willingly and be loyal, in thoughts, words, and actions, to his seniors, to his juniors, and to all proper authority. When he has done this he is ready to do his part to the utmost of his ability in maintaining good order and discipline among others by the proper exercise and use of the authority, trust, and confidence reposed in him by virtue of the position he holds in the Navy.

What is always necessary in order to attain and maintain efficiency? A high morale or *esprit de corps*.

How may a petty officer aid to his utmost in attaining and maintaining a high morale in the command? Principally by showing in himself a good example of the worthy quality set forth in this article; by not abusing or misusing his authority; by being fair and square to everyone, and giving due consideration to the other fellow; by being as human and humane as conditions will admit; by displaying an active interest in his subordinates' welfare, contentment, and performance of duty; by personally encouraging others to utilize their ability to make themselves and others happy whether in performance of duty or recreation or amusement; by giving instruction, advice, admonition, exhortation, and commendation as his authority and duties will permit to his juniors; by taking a personal interest in everything for the good of the command and personally encouraging others by giving personal attention to small things as well as big things; by being polite and courteous; by saluting as required; by giving loyal support to the policies of his seniors without any mental reservations or secret evasions whatsoever; by being true to himself and to his fellows and actuated in all his dealings by the highest standards of character, having proper regard for the requirements of the regulations, and ever remembering his oath of allegiance given upon enlistment.

Paragraph (3) of article 1275 needs no explanation as to its meaning, except to remember that the reputation of the Navy ashore is dependent principally upon the conduct of its personnel ashore.

This paragraph reads as follows:

"For the preservation of good order petty officers are always on duty and are vested with the necessary authority to report and arrest offenders. This authority attaches to them while ashore or on liberty."

Every organization requires a system of supervision of some sort, and in our Navy petty officers form a part of its system of supervision. The spirit of performance and attention to duty as exemplified by seniors is often reflected in their juniors and for this reason it is important that all having any degree of authority must be careful as to the example shown to subordinates.

Is it not manifest why the Navy Department attaches such importance to article 1275 of the *U. S. Navy Regulations, 1920*? The efficiency of our petty officers depends upon the maintenance of this standard at all times.

THE CABLE CUTTERS OF CIENFUEGOS

By Carlos C. Hanks

THE blockade of the entire Cuban coast line by the United States naval forces during the Spanish-American War had become virtually effective by the first of May, 1898, and the island was practically isolated from Spain so far as the landing of food, munitions, and mail was concerned. There was, however, one means of communication still available for the Spanish Governor General, Blanco, at Havana. This was the group of ocean cables connecting Cuba with many of the islands in the West Indies and thence to the home government in Madrid.

The task of severing this last link with Spain was entrusted to the Navy, whose plan of operation was simplified by the knowledge that no ocean cables were landed on the north coast of Cuba save those connecting Havana directly with Key West and thus controlled by the United States. On the south coast the cables were looped along the shore from Batabona to Guantanamo Bay; the more northerly loops touching at San Luis, Cienfuegos, Trinidad, and Santiago de Cuba. Because of this arrangement it was only necessary to cut the cables at Cienfuegos, or some point to the eastward of that town, and Havana would lose her last connection with the outside world.

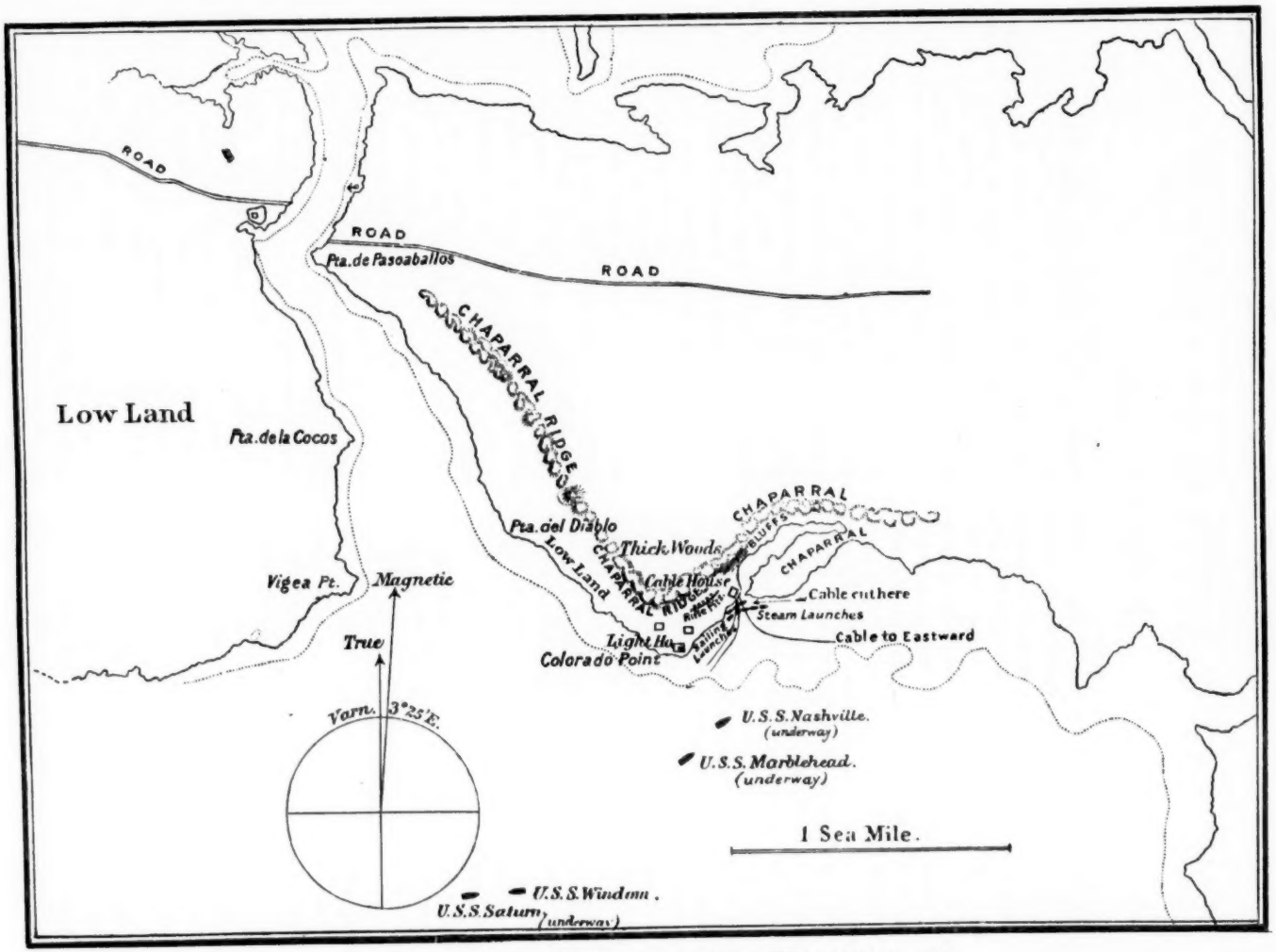
The fourth division of the United States fleet was operating on the south coast of Cuba during the early part of May at the time the Cienfuegos cables were cut. This force consisted of the cruiser *Marblehead,* the gunboat *Nashville,* the converted yacht *Eagle,* the revenue cutter *Windom,* and the collier *Saturn,* all under the immediate command of the senior officer present, Commander B. H. McCalla of the *Marblehead.*

The town of Cienfuegos lies almost six miles from the sea, and the bay which comprises its harbor is entered by a channel three miles in length. The lighthouse on Colorado Point guarded the eastward side of this entrance, the low strip of land being studded by rock formations, trees, and dense Cuban chaparral. The lighthouse itself was built about twenty-five yards from the shore line and was flanked by a signal station and a small barracks for signal men and the military guard. About 300 yards east of the lighthouse stood the cable house. This, too, was close to the water's edge.

From east of the cable house westward to the channel entrance, coral formations along the shore made navigation of small boats extremely hazardous, while the Spaniards had taken defensive measures in the form of rifle pits and trenches so well screened by rocks and vegetation, that if watchful American eyes had not seen men digging in these trenches, the existence of such defenses would not have been known.

Late on the afternoon of May 10, the *Marblehead* hoisted a signal that summoned the commanding officer of the *Nashville,* and Lieutenant Cameron McR. Winslow, also of that ship, aboard the cruiser. When these officers reported, Commander McCalla made known his decision to attempt the cutting of the cables at dawn of the following morning. He directed that a boat expedition, commanded by Lieutenant Winslow, be sent in to find and cut the cables, while the *Marblehead* and *Nashville* shelled the Spanish works. He also named Lieutenant E. A. Anderson of the *Marblehead* as second in command and designated the steam cutter and sailing launch of the cruiser, and the steam cutter and sailing launch of the *Nashville* as the boats to be used.

With further details of the expedition left entirely to the judgment of the two officers responsible for its success, Lieutenants Winslow and Anderson determined that each sailing launch should be manned by a coxswain, a blacksmith, carpenter's mate, and twelve men, which, with the officer, made a crew of sixteen. Half of the men were to be armed with rifles and the remainder with revolvers. An ample supply of ammunition and a few extra rifles were put in each boat.



CABLE CUTTING OPERATIONS, CIENFUEGOS, CUBA, MAY 11, 1898

The crew of each steam cutter included a coxswain, two seamen, a fireman, and a coal passer. In addition each carried a sergeant and six privates of the Marine Corps, as well as an officer in charge. The *Nashville's* cutter mounted two Colt machine guns, while that of the *Marblehead* carried a one-pounder Hotchkiss rapid-fire gun forward. The cable-cutting tools, to be carried in each sailing launch, consisted of a heavy maul, blacksmith's hammers, cold chisels, an iron-plated block of wood, an ax, wire-cutting pliers, and a hacksaw. Grapnels of several sizes for catching and bringing cables to the surface were also provided.

The cable landing at Colorado Point had a central conductor consisting of a strand of seven copper wires, insulated by a gutta-percha coating. These wires were housed in a lead tube as a protection against the attacks of the submarine boring teredo. Outside of this tube were two layers of heavy iron wires, the inner consisting of twelve, and the outer of fourteen, wires. Surrounding the whole and forming the external surface of the cable was jute braiding. The whole cable was two inches in diameter and weighed fully six pounds a linear foot.

At a quarter to seven on the morning of May 11, the *Marblehead* and *Nashville* began a deliberate and careful bombardment of the Spanish works, and buildings, using both main and secondary batteries. Ten minutes later, while the ships were still firing, the four boats pulled clear of the *Nashville's* starboard side, and headed for the beach, the *Nashville's* boats leading, the steam cutters towing the launches.

With the boats away, the ships concentrated their fire on the cable house and soon reduced it to a heap of crumbled masonry covering the wrecked electrical instruments. As the boats neared the shore, the ships slackened their fire and the small guns of the steam cutters opened on the rifle pits.

When about 400 yards from the beach, the steam cutters cast off the towlines and took position in deeper water to the rear of the launches. The latter boats manned the oars and pulled directly for the cable house as the cutters maintained their fire from about 100 yards astern.

Nearer and nearer the boats approached the land, unmolested by hostile fire until, at about 100 feet from the shore the bottom was sighted and the grapnels were thrown overboard. The coral formations on the bottom prevented dragging, however, and the boats continued their advance until the *Marblehead's* launch suddenly sighted the submerged Santiago cable and grappled it. The *Nashville's* launch immediately went to her assistance and both boats hooked firmly to the cable.

As the heavy mass broke surface under the lifting efforts of thirty men, ropes were passed under it and it was gradually lifted over the stern and into one boat, then more easily into the other. After both boats were in line under the cable, the steam cutters took towlines from the seaward boat and went ahead at full speed. The cable was slowly overrun until a depth of about two fathoms was reached. At this point, the *Nashville's* launch stopped and began cutting operations while the *Marblehead's* launch worked a little further on dragging the cable across the boat to provide slack.

Axes and cold chisels were tried, but the small 9-inch hack saw was found to be most effective. With this saw, and by frequent changing of the men using it, the cable was severed in about half an hour. Having made the first cut, the *Nashville's* launch, following the *Marblehead's* launch, underran the cable, bending it and coiling it down in the stern sheets. This cable was underrun until it was found to pass under a ledge of coral from which it could be freed. While attempting to clear it, a heavy sea swept over the *Marblehead's* launch, held down by the weight of the cable, and almost swamped the boat. After this narrow escape no time was lost in making the second cut, this time by the *Marblehead's* men, and the end was dropped over in thirteen fathoms of water. The piece cut out was about one hundred and fifty feet long.

Up to this time the enemy fire had been spasmodic and ineffective, and no attention had been paid to it by the working parties who, without pausing to rest, immediately began to search for the cable running westward to Batabano. The boats pulled westward of the cable house and pulled in until they were a scant sixty feet from the land.

The ships, realizing that the boats were within easy range of the rifle pits, opened a steady and well-directed fire, even though there was risk of hitting their own people. The men in the boats knew that they had to chance both an accidental hit from their

ships and receive the fire of the enemy at close range, and yet they worked on in total disregard of both.

The weary crews soon located the second cable, but found it difficult to grapple, for the sea, breaking against the coral shore line, rolled back in a smother that blotted out vision of the bottom. When it was finally hooked this cable was harder to lift for the rough water knocked the heavy boats together, splintering and battering in their planking.

Whenever the fire from the ships slackened the enemy opened on the boats with rifles. Lieuntenant Winslow would order the steam cutters to open fire, and the ships, seeing the boats engaged began their hammering again. The cable was finally lifted, and handled in the same manner as the first, the *Marblehead's* launch cutting the shoreward end with the *Nashville's* launch making the seaward cut about 100 feet beyond.

While disabling the second cable, a third, and much smaller one was discovered in close proximity. Lieutenant Winslow rightly judged this to be the connection between the cable house and Cienfuegos, and though of little importance the commander of the expedition decided to disable it as well, because he believed little time would be required for the cutting operations.

The rifle pits had practically ceased firing as the boats grappled the third cable and the watchful ships had consequently silenced their batteries. The rough water and the utter weariness of the men delayed the work, but the *Nashville's* launch finally hooked the cable about fifty feet from shore. Suddenly the enemy, evidently reënforced, opened a furious rifle fire that threw up sheets of spray about the boats. The steam cutters at once replied and soon shrapnel from the ships was racketing among the ruined buildings and rifle pits.

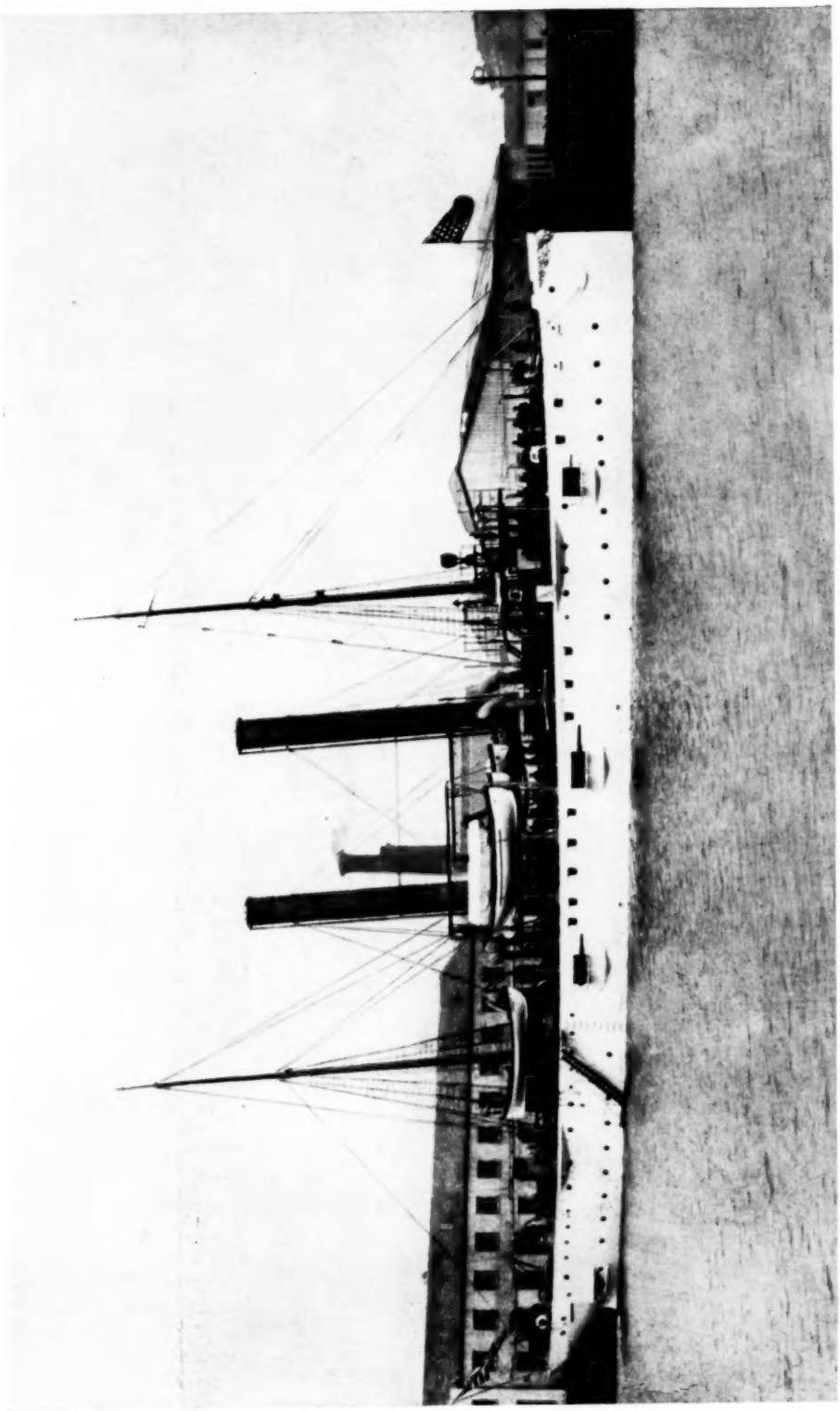
Hoping that the ships would be able to check the enemy's fire, the working parties toiled on until they finally brought the cable to the surface. Instead of abating, the Spanish fire increased and bullets whined around the boats. Lieutenant Winslow, surveying the situation from the *Nashville's* launch, saw a marine fall in the *Marblehead's* steam cutter. Turning to scan Anderson's boat, the *Marblehead's* launch, he saw one of her men drop. As his gaze returned to his own boat, he saw seaman Robert Volz fall, wounded in four places.

The enemy's fire, now very severe, had been augmented by machine guns and a fieldpiece. It was evident that no work could be done in the face of such opposition and Lieutenant Winslow ordered both launches to cease work and to open with their rifles. It was soon evident that the combined fire of ships and boats could not overpower the enemy so Lieutenant Winslow, who had been wounded in the hand by a Mauser bullet, ordered the steam cutters to stand by to tow the launches, and the launch crews to begin pulling their boats clear of the breakers. Ensign T. P. Magruder skillfully brought the steam cutters in, the launches were soon in tow and the boats made for the ships. Five men were wounded in the *Marblehead's* two boats as they headed seaward.

The *Nashville,* commanded by her executive officer, Lieutenant A. C. Dillingham, after Commander Maynard had been wounded by a spent Mauser bullet, came along the reefs from the eastward and interposed herself between the boats and the enemy. At the same time, the *Marblehead* and *Windom* drew closer inshore and directed a storm of shell at the Spanish works and completely demolished the lighthouse.

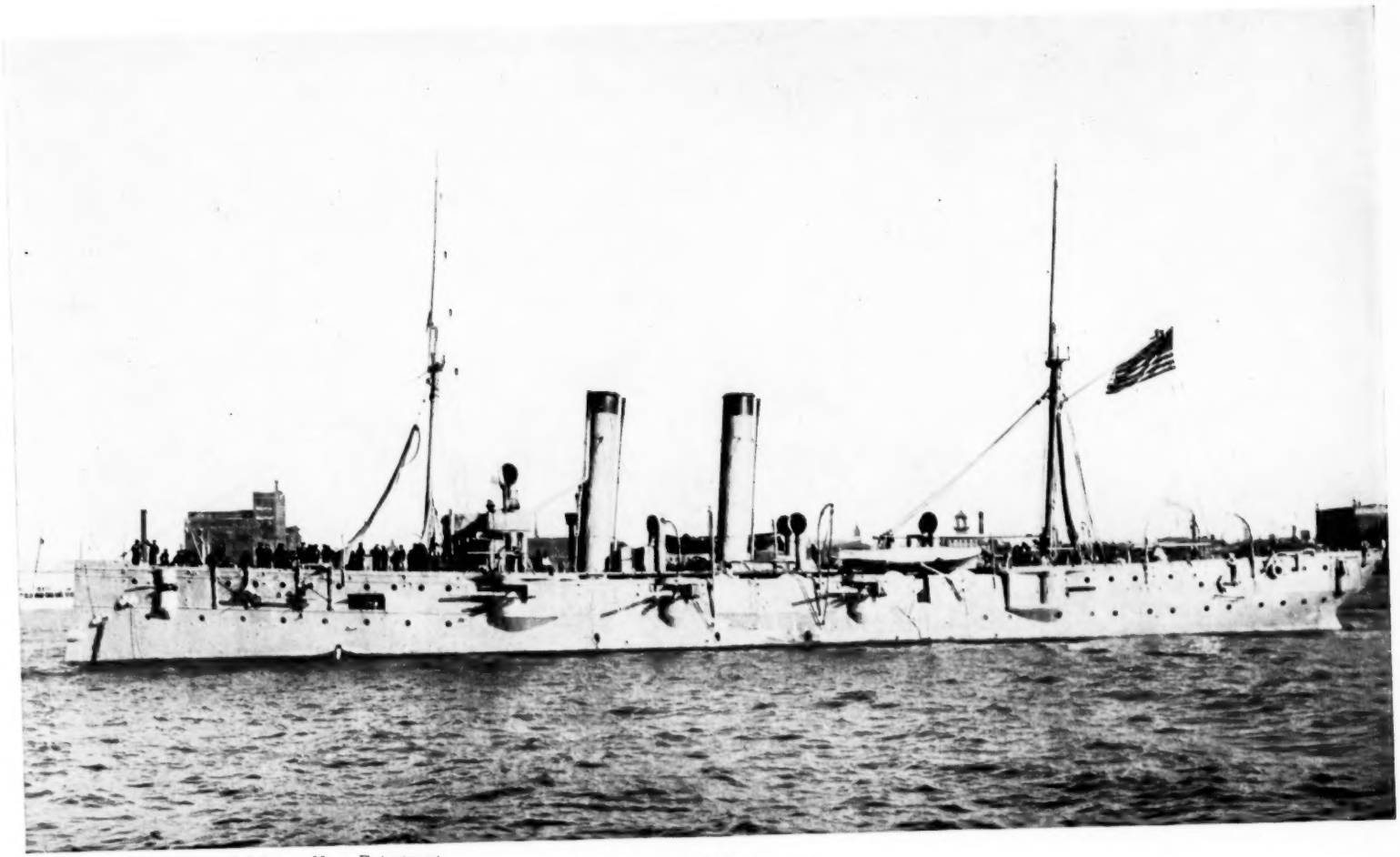
At eleven thirty the firing ceased and the ships stood out to sea. On board the *Nashville,* which had been closer to the shore while the boats were working, her commander, Ensign Snow, Pay Clerk Southgate, and several enlisted men had been slightly wounded by spent bullets, during the more than three hours that ship was within range. Of the working parties, two men were killed, six men severely wounded, and one officer slightly wounded. The planking of the boats was pitted and scarred, both inside and out, by bullets, while the *Nashville* bore marks left by enemy fire, from her water line to the tops of her tall smokestacks.

A few days after the fight, Commander McCalla received a report from Cuban insurgents that the enemy had lost 300 in killed and wounded. This figure was probably fairly correct as the Spaniards, believing that a landing in force was planned by the Americans, had marched an infantry regiment to the threatened point, and had about 1,500 men in the action.



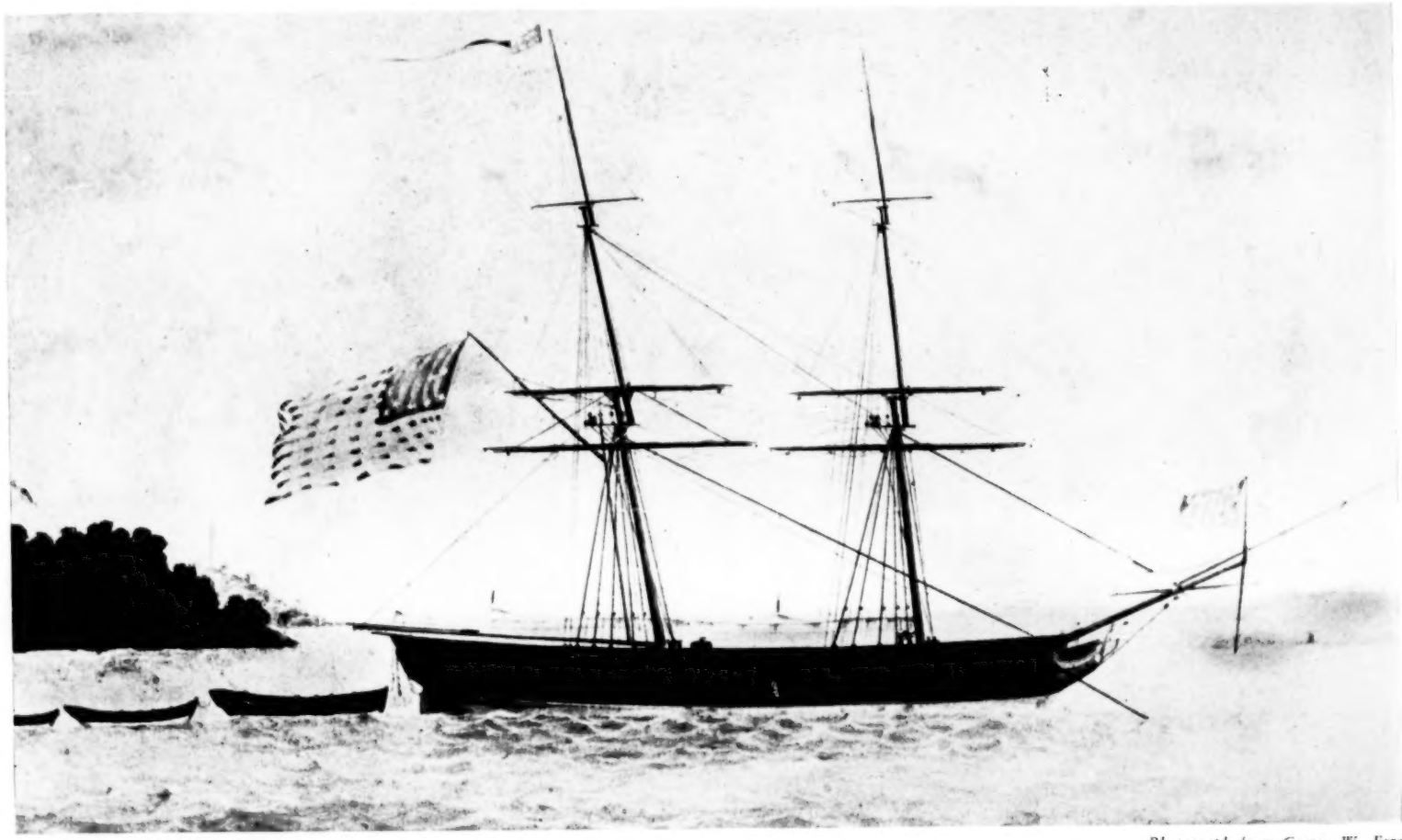
U.S.S. *NASHVILLE*, 1898

Courtesy Naval Records and Library, Navy Department



Courtesy Naval Records and Library, Navy Department

U.S.S. *MARBLEHEAD*, 1898



Courtesy Naval Historical Foundation *Photograph from George W. Eyre*

AMERICAN BRIG *HIBERNIA*

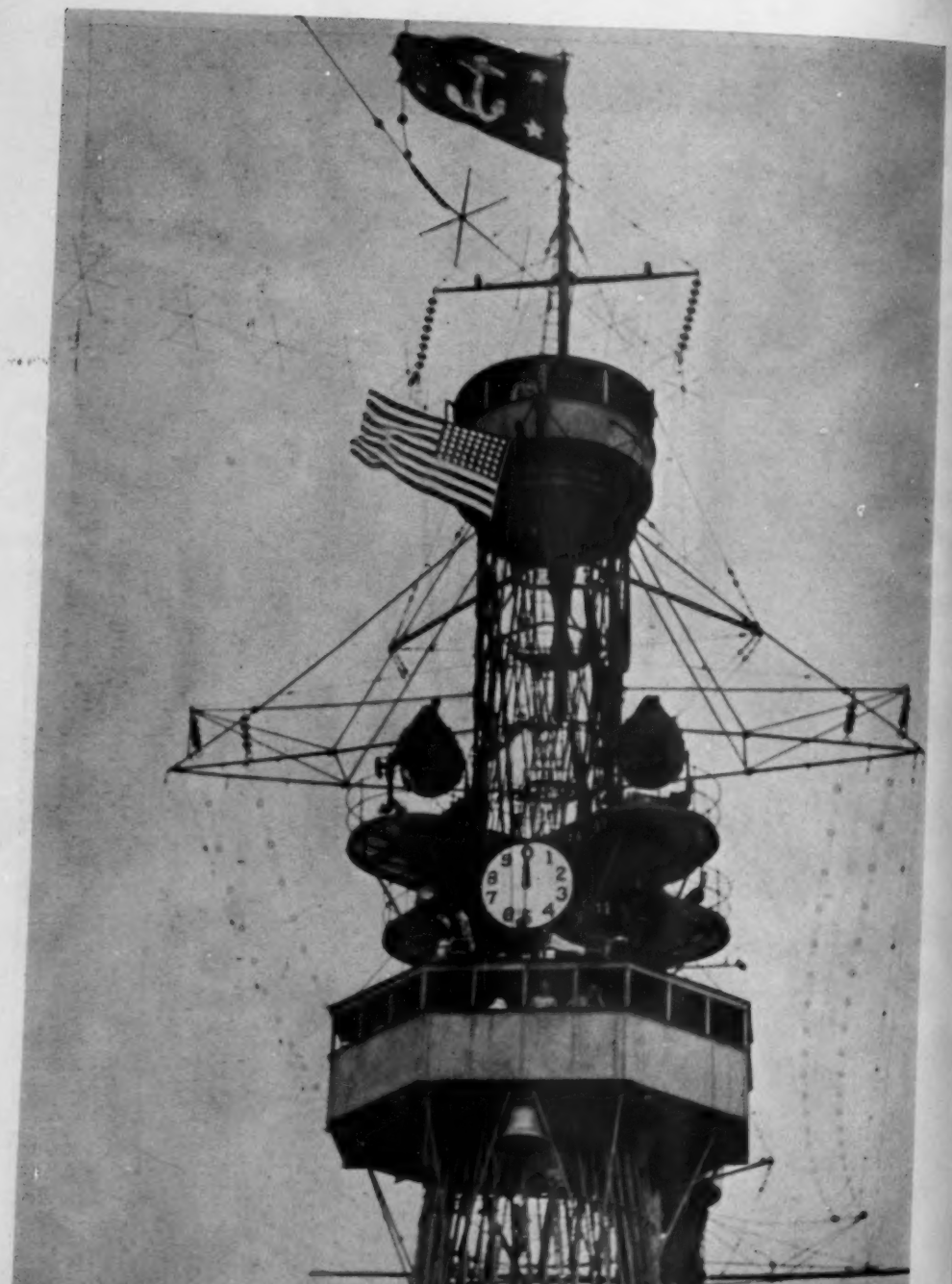
This is an enlargement of the photograph taken about 1875 from original painting on rice paper. The photograph shows the *Hibernia* as she was at anchor off Canton, China, about 1790. Painting by an officer of the ship.

By Ewing Galloway, New York

THE OLD FRENCH MARKET, NEW ORLEANS

Courtesy U. S. Naval Air Station, Anacostia, D.C.

THE PRESIDENT'S FLAG DURING FLEET REVIEW, HAMPTON ROADS, VIRGINIA



Courtesy Navy Recruiting Bureau, New York

SECRETARY OF THE NAVY'S FLAG FLYING FROM THE *PENNSYLVANIA*

THOSE THAT ARE CARRIED IN THE TOPS OF SHIPS

By Helene Philibert

ADMIRAL: Let me hear somewhat from you about the Ceremonial Custom and use of carrying out of Flags."

"CAPTAIN: Flags, my Lord, to speak properly, are only those which are carried in the Tops of Ships, and they serve as Badges, and that as well for the distinction of Nations, as Officers and Commanders: And so the Admiral of a Fleet or Squadron hath his Flag at the Main-top, the Vice-Admiral at the Fore-Top, and the Rere-Admiral in the missen-top, with the Crosses or Colours of their Nation and Countrymen. And thus far it is usual and common even with Fleets of Merchant Men, agreeing amongst themselves for the Admiral Ships in this kind. But in a Fleet Royal, consisting mainly of Men-of-War; whensoever either the Prince is there in Person, or his High Admiral in his room, there is carried out in the Main-top of the Admiral Ship, where he himself is, instead of one of these ordinary Flags, the Standart Royal, which is the Arms of the Kingdom."

This dialogue was recorded by Commander N. Boteler, formerly in one of "His Majesties Royal Ships," in 1685 and was published in London in 1688. Over two hundred years later the regulations of the United States Navy provided: "The President's flag shall be displayed at the main."

The regulations of the Navy of 1865 prescribed that the American ensign displayed at the main should denote the presence of the President on board a naval vessel, but a year later regulations required that the union jack, with white stars equal to the number of states of the Union, should fly at the mainmast while the Chief Executive was aboard. Then again, this later regulation was canceled, and the national ensign at the main was again the president's flag, and was used as such until 1882, when a distinctive flag was designed for the President and that design was approved by President Arthur.

The flag of 1882 consisted of the coat-of arms of the United States on a blue field with thirteen stars formed in a bow over the eagle. This flag was used for nineteen years by the various presidents. In 1898, the Army designed a president's standard for the Army, but President Roosevelt in 1901 decided that the Navy's flag, being the older, should be the official flag of the President.

When President Wilson made the fiftieth review of the Grand Army of the Republic in 1915, two presidents' flags (Army and Navy) were displayed on the platform of the reviewing stand. This caused considerable comment in the press and in the services, and, as a result, the suggestion was made that the President should have one flag made distinctive, for the Navy flag was almost identical with the infantry colors. As commander in chief of the Army and Navy, the President was given four stars—one in each corner of the flag, similarly arranged as the flag of an admiral or general, and President Wilson directed that his seal—the personal seal of the President of the United States—be used instead of the coat-of-arms of the United States. Today two President's flags stand guard over the tomb of President Wilson in the National Cathedral, Washington, D.C. One is the flag designed by the Navy and the other, the flag designed at his direction.

When President-elect Hoover boarded the battleship *Maryland* for his visit to Central and South America, he was accorded honors that are provided by Navy Regulations for an ex-president, as no provisions are made in the regulations for honors to be given a president-elect. A precedent for this may be found in the visit of Chief Justice Taft, who as President-elect, went to Panama on the U.S.S. *North Carolina*

in January, 1909, with a party of engineers to inspect the Panama Canal. Mr. Taft was given a salute of twenty-one guns on boarding and leaving the *North Carolina*, both at Charleston, S.C., and at Colon, C.Z.

The honors for a former President are the same as those prescribed for the President of the United States except that the rail is not manned, and the ruffles and flourishes are followed by a march instead of the "Star Spangled Banner." No flag was displayed in honor of Mr. Hoover as he boarded the *Maryland* and during the salute, but, upon embarking upon the *Utah* for his return voyage to the United States, the national ensign was displayed at the main during the salute.

The barge used by Mr. Hoover from ship to shore carried in its bow the union jack.

Presidential honors have been accorded presidents-elect of foreign republics during their visits to naval ships and stations. When General Plutarco Calles, President-elect of Mexico, in November, 1924, and General Gerardo Machado, President-elect of Cuba, in April, 1925, visited the Washington Navy Yard, the band and the guard were paraded on the dock near the Sylph, a salute of twenty-one guns was fired from the saluting battery, and the national ensign of the distinguished guest was broken on board the *Sylph* as he embarked. The officers were in full dress and the crew in dress blue. A second salute was given when the national ensign of the guest's country was hauled down upon his disembarkation from the *Sylph*.

While no regulations specify the use of a distinctive flag for a Vice President of the United States, a specially designed flag has been used, at least twice, to show his presence on board a naval vessel as the representative of the President of the United States.

A clipping from the New York *Times* of March 16, 1915, follows:

Washington, D.C., March 15.—The Vice President of the United States is to have a flag. Whenever he visits an American warship his flag will flutter from the masthead. The flag will be a snow-white square of bunting, on the field of which will be a bluebird representing the eagle in the coat-of-arms of the United States. The President's flag consists of the coat-of-arms of the nation on a blue field.

This is the first time that there has been prescribed for the Vice President a distinctive flag to be displayed on naval vessels while he is on board. The President, secretaries, and assistant secretaries of the Departments of War and the Navy have distinctive flags. The admirals, vice admirals, and rear admirals have distinctive flags.

It remains for Secretary Daniels to provide the Vice President with a flag. His action grows out of the fact that Mr. Marshall is going to San Francisco to represent President Wilson at the exposition; he is to be received on board the cruiser *Colorado*, the flagship of Admiral Howard, commander in chief of the Atlantic Fleet. Hence the new flag will be a permanent institution of honor to the Vice President.

An extract from the log of the *Colorado*, March 22, 1915, shows:

Meridian to 4:00 P.M.

1:00 Full dress ship . . . 3:15 Vice President came aboard, lowered the flag of the Assistant Secretary of the Navy and hoisted Vice President's flag at the main and fired a salute of nineteen guns . . . .

R. M. GRISWOLD,
Lieutenant, U. S. N.

The second occasion was during the visit of the King of Belgium to Washington. On account of the illness of President Wilson, Vice President Marshall was the host on board the *Mayflower* when the royal party made a pilgrimage to Mount Vernon. A flag was designed for the Vice President in the Navy Department and was flown with the national ensign of the King of the Belgians on the presidential yacht.

The log of the *Mayflower*, October 29, 1919, reads:

Meridian to 4:00 P.M.

12:25, yard battery rendered salute to Vice President; 12:35, Vice President came aboard; was rendered usual honors and his flag hoisted at main truck. 12:44, Secretary of the Navy came aboard, and was rendered usual honors. 1:24, yard saluting battery rendered a salute of twenty-one guns to King of the Belgians. 1:27, King of the Belgians came aboard and was rendered national honors, and the Belgian national ensign was hoisted at main truck, and vice president's flag shifted to fore truck. Secretary of State, Secretary of War, and many other official guests came aboard. 1:32, got under way for Mount Vernon, in accordance with verbal orders of the Secretary of the Navy. Standing down the Potomac on various courses, pilot at the conn. 2:38, Mount Vernon abeam, starboard side, distant 600 yards. Rendered usual honors. 2:44, anchored with starboard anchor in five fathoms water . . . . 3:18, King and Queen of Belgians, Vice President, Secretary of the Navy, and other officials left ship to attend the ceremonies. Rendered all necessary honors; hauled down Belgian ensign and Vice President's flag. 4:30, party returned; rendered honors, and hoisted Belgian ensign at main and Vice President's flag at fore.

D. B. CALDWELL,
Lieutenant (J.G.), U. S. N.

In 1920, President Wilson signed an executive order establishing an official flag for the Secretary of State.

EXECUTIVE ORDER

Whereas it frequently devolves upon the Secretary of State in virtue of the statutory authority conferred upon him to perform public acts of foreign intercourse under direction of the President:

And whereas, it is proper that in the performance of such ceremonial acts as the representative of the President, it is appropriate his representative function be designated by an appropriate flag, to be displayed when occasion may require:

Therefore, I, Woodrow Wilson, President of the United States, do hereby direct and prescribe than an Official Flag, indicative of the office of Secretary of State, be prepared as follows:

The ground or field of such flag to be dark blue with the arms of the Department of State in white charged upon the center, and with a gold star on each side of the arms.

And I further direct that on the approaching ceremonial visit of the Secretary of State to certain States of South America, the above prescribed flag shall be displayed on the national vessel which conveys him, so long as he shall be on board the ship, and upon the launch which may convey him to the shore when his communication therewith becomes necessary in the discharge of the public mission with which he may be charged.

WOODROW WILSON

The White House
28 November 1920.

Secretary of State Bainbridge Colby, in December, 1920, and Secretary of State Charles E. Hughes in August, 1922, used this flag on their visits to South America. A more recent use was the occasion of the visit of Secretary of State Kellogg to the Irish Free State. After the signing of the peace pact in Paris, Mr. Cosgrave, President of the Council of Ministers, Irish Free State, and Secretary Kellogg took passage on the light cruiser *Detroit* from Havre to Dublin. The log of the *Detroit* states:

August 29, 1928.
11:00, Secretary of State, Mr. Frank B. Kellogg, came on board for passage to Kingstown, Ireland. Was received with appropriate honors and Secretary of State's flag was broken at the fore.

Upon arrival at Kingstown, on August 30, 1928, the *Detroit* hoisted the flag of the Irish Free State and fired a national salute of twenty-one guns. The salute was returned by a battery on shore flying the United States ensign. As President Cosgrave left the ship, he was escorted to the gangway by Secretary Kellogg and Vice Admiral Guy Burrage, U.S. Navy, Commander of the United States Naval Forces in Europe. Mr. Cosgrave embarked while the band played and a personal salute of nineteen guns was fired as his national flag was flying. When Secretary Kellogg embarked in the same launch, a personal salute of nineteen guns was given the American flag at the fore. When the salute was completed, his personal flag as Secretary of State was hauled down from the *Detroit*.

The foul anchor on a field of blue has been the distinguishing flag of the Secretary of the Navy for many years. It was authoritatively established as the insignia for the head of the Navy by the regulations of 1865, but more than a century before, the lord high admiral of England had issued regulations designating the foul anchor as the symbol of his office.

The anchor of the British Admiralty differs from the one used by the United States Navy in design and position. In the British flag, the shank of the anchor is in a horizontal position while the American Navy uses the foul anchor in a vertical position on its flags.

Commander C. N. Robinson, Royal Navy, in *The British Fleet*, states that up to the late Tudor or early Stuart period:

The Admiralty badge was a crescent moon, horizontal with a golden star between the horns, but about that time the crescent was replaced by the anchor which was also used as a seal with a motto round it according to the fancy of the Lord High Admiral. When the Earl of Northumberland was in office, the anchor had a cable festooned about it in a wonderful manner. The Duke of York put this anchor into the Admiralty flag. About 1720 the foul anchor which had before been the badge of the victualling officer was taken for the Admiralty and it was put into the seal, badge and flag. In 1815, the clean anchor was restored to the flag, but the foul anchor remains the badge at Whitehall.

Navy regulations of 1865 provided:

For the Secretary of the Navy, a blue rectangular flag with a white foul anchor, placed vertically in the center, with four white stars in each corner of the flag surrounding the anchor; this flag to be hoisted at the main royal masthead whenever the Secretary of the Navy embarked on board a vessel of the Navy, while he remained on board, and to be carried at the bow of any boat or tender in which he embarked. The flag of the Secretary to be saluted with fifteen guns.

With the changes in naval regulations, the union jack, hoisted at the main, was the distinguishing flag for the Secretary of the Navy in 1870. The flag with the foul an-

chor was restored on July 4, 1876, and has been in use continuously since then. The flag for the Assistant Secretary was authorized July 13, 1892, by B. F. Tracy, Secretary of the Navy.

The Secretary of War's flag is flown at his direction, at Army posts, when reviewing troops, and when he is on board ship. This flag was designed in 1897 and its origin is described by Secretary of War Lamont, who said when he signed the general order for its use:

> When I entered upon my duties as Secretary of War four years ago, one of the papers I found awaiting action on my desk was a recommendation from General Schofield, then at the head o the Army, in favor of a special flag for the Secretary of War. I thought that to begin my official work by ordering a flag for myself was not exactly a graceful thing to do, so I allowed the matter to drop until the end of my term.
>
> Then I realized that my successor would find himself in the same predicament in which I had been four years before, so I made one of my last official acts the approval of the order for the flag. But in the beginning it was General Schofield's idea.

When his successor, Secretary of War Alger, visited Sandy Hook, this flag was flown for the first time from the steamer *General Meigs* on July 2, 1897.

Today, the Secretary of War has prescribed for his use by Army regulations a flag, colors, a boat flag, and an automobile flag. These flags have a scarlet field with a white five-pointed star in the four corners. In the center of the flag is the coat-of-arms of the United States. The flags for the Assistant Secretary are reversed in color, with a white field and scarlet stars with the coat-of-arms of the United States in the center.

No record can be found of the origin of the Secretary of the Treasury's flag and, while it has been flown for a number of years, search of the files of the Treasury and of the Coast Guard has failed to throw any light on its authorization. Certain of the early files of the Treasury Department were burned and it is believed that if any order did exist, it was destroyed with the files. The design of the Secretary of the Treasury's flag has been revised in accordance with the following letter from Secretary Mellon:

> 12 September 1928.
>
> I hereby prescribe that the distinguishing flag now used by the Secretary of the Treasury shall consist of the Seal of the Treasury Department on crossed anchors of white on a blue field, encircled by thirteen white stars, and that the distinguishing flag now used by an assistant secretary of the treasury shall consist of the same design as the Secretary's flag, with the seal, crossed anchors and stars of blue on a white field.
>
> A. W. MELLON

The regulations of the Coast Guard provide that when the Secretary of the Treasury takes passage on Coast Guard vessels, his flag shall be broken out at the main and kept flying as long as he is on board.

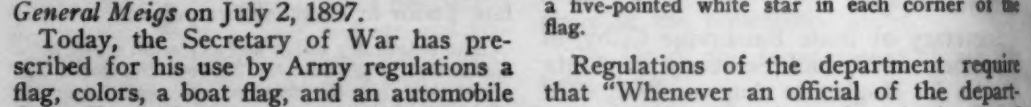
The flag of the Secretary of Commerce was designed in 1915 and is described in a department circular:

> The flag of the Secretary of Commerce will be a full-rigged ship, in blue, over a lighthouse in blue, in a white shield on a blue field, and have a five-pointed white star in each corner of the flag.

Regulations of the department require that "Whenever an official of the department having a flag is on board of a vessel belonging to the Department of Commerce his flag shall be displayed at the main."

The flag of the Secretary of Labor was designed about the time of the organization of that department, March 4, 1913. It is flown at the direction of the Secretary. When Secretary James J. Davis went to South America in 1924 on an official visit, this flag was flown on the SS. *Southern Cross* while he was a passenger.

The flag consists of the seal of the Department of Labor on a blue field with four white stars.



THE FLEET AND THE MARINES

By Lieutenant Commander E. W. Broadbent, U. S. Navy

TWO armies! One under the War Department, the other under the Navy Department. One, the United States Army, the other the United States Marine Corps. The former numbers about 130,000, in peace time, the latter numbers about 18,000.

At first glance this seems to be an anomalous condition, a duplication of effort. Why should the Navy maintain its own army? What does it do with this army? The answer to these questions lies almost entirely in the one word "bases." Naval bases constitute the sources of supplies, the ports of refuge for repairs, overhaul, and maintenance, to which a fleet may retire for recuperation and refitting. Lying on the edge of hostile zones, perhaps thousands of miles from the homeland, the naval bases constitute a vital, indispensable link in the chain of maintenance of the fleet at sea.

Diplomacy and ancient campaigns have provided some navies with far-flung bases circling the globe. Ours is not one of those fortunate navies. During the World War our naval forces abroad used the naval bases of our allies. May we always have such complacent and well-situated allies!

But suppose we haven't! The only answer is, we must seize our bases. To seize bases, we must have suitably organized expeditionary forces. Hence the Marine Corps. Our fundamental naval policy includes the following requirement: that we "maintain a Marine Corps of such strength that it will be able adequately to support the Navy by: (a) furnishing detachments to vessels of the fleet in full commission; (b) guards for shore stations; (c) garrisons for outlying positions; (d) by the maintenance in readiness of an expeditionary force."

But, one may ask, why should not this expeditionary force come from the Army? Our fundamental naval policy requires that we "develop and organize the Navy for operations in any part of either ocean." Time is an essential element in all military operations; so is mobility. But mobility is not only essential to a fleet, it is also vital and indispensable. Experience has shown that when mixed military and naval forces are engaged in a joint operation, unity of the highest command is essential to success. Admiral Nelson experienced difficulties in his landing operations due to lack of direct command over the military as well as the naval forces. These same difficulties were repeated as recently as the World War at Gallipoli. The subject is hoary with age. But the net result is that dual command of mixed forces does not work. The law of the land does not permit an Army officer to exercise command of naval forces, nor a Navy officer to exercise command of Army forces. The obvious solution is to provide the Navy with its own landing force, and as we said before, hence the Marine Corps.

Now that we have the Marine Corps, what shall be done with it? Major General John A. Lejeune, U.S.M.C. (Ret)., said, "From its very establishment, the Marine Corps has constituted an integral part of the Navy. It has played its part with the Navy in all its achievements, both ashore and afloat." (Foreword; Proceedings, U. S. Naval Institute, November, 1928). More recently, the late Major General Eli K. Cole, U.S.M.C., said, in part, "The major war mission of the Marine Corps is to support the fleet by supplying it with a highly trained, fully equipped expeditionary force for the minor shore operations which are necessary for the effective prosecution by the fleet of its major mission, which is to gain control of the sea and thereby open the sea lanes for the Army overseas." (Proceedings, U. S. Naval Institute, November, 1929). Although the latter quotation is somewhat involved, its import is clear, namely that the primary mission of the Marine Corps in time of war is to conduct

minor land operations for the support of the fleet.

A recent publication, *Joint Action of the Army and Navy*, approved by the Secretary of War and the Secretary of the Navy in April, 1927, and issued by them to the two services "for information and guidance" states the following functions of the Marine Corps, as "an adjunct of the Navy:"

> To provide and maintain forces:
> (a) For land operations in support of the fleet for the initial seizure and defense of advanced bases and for such limited auxiliary land operations as are essential to the prosecution of the naval campaign.
> (b) For emergency service in time of peace for the protection of the interests of the United States in foreign countries.
> (c) For marine detachments on vessels of the fleet and for interior protection of naval shore stations.

The war-time mission of the Marine Corps will be found clearly stated in the first section above, namely, "to support the fleet by conducting land operations for the initial seizure and defense of advanced bases and by such limited auxiliary land operations as are essential to the prosecution of the naval campaign." To quote again from the Navy's fundamental policy: "To make war efficiency the object of all training, and to maintain that efficiency during the entire period of peace," and again, "to maintain a Marine Corps of such strength that it will be able adequately to support the Navy—by the maintenance in readiness of an expeditionary force." "Readiness" for what? From the foregoing it would seem that the Navy Department expects the Marine Corps to be at all times organized and trained to fulfill its primary war mission, that is, the seizure and defense of advanced bases. Is the Marine Corps so organized and trained? Later on, we shall have occasion to ask a similar question of the Navy.

Four years ago, in 1925, an extensive joint exercise was held in Hawaiian waters. The fleet, assisted by the Marine Corps as the landing force, attacked and attempted to establish an advanced base in Hawaiian waters. The islands were defended by the Army garrison and the local naval-defense forces. This exercise was the most elaborate joint Navy-Marine Corps operation ever planned and executed. The lessons learned from the operation emphasized the need for extensive study of the whole subject of forced landings. Previous landing exercises had been conducted on a small scale, and valuable lessons learned, but the broad importance of this type of operation had never been clearly demonstrated as in the exercise of 1925.

Two years later the study of landing operations was taken up at the Naval War College and at the Marine Corps schools at Quantico, Virginia. Some effort had been made by the Army previously to investigate the subject, inspired by the Army's task of defending our shores from attack. At Quantico an extensive course in joint overseas operations was introduced into the curriculum, and a naval officer was detailed to the staff of the schools to assist in the presentation of such features of the subject as were purely naval.

There can be no more appropriate place for the study of this subject, from the standpoint of the land operations, than in the Marine Corps school. For years the Marines have recognized the fact that reading, study, and instruction in all the branches of the military profession are essential to efficiency in their rôle. The corps has maintained four schools in which their officers receive their fundamental training in tactics. These schools are the Basic School for all newly commissioned second lieutenants; the Company Officers' and Field Officers' Schools, and the correspondence schools for all officers, including reserves. But lack of time and facilities have limited the work covered in these schools to bare necessities. To amplify their training, and to produce the group of specialists necessary to thorough development of all branches of their service, officers of the Marine Corps have been detailed to courses of instruction in many of the schools of the Army and the Navy. Included in these schools are:

Army: Infantry, Field Artillery, Cavalry, Aviation, Motor Transport, Chemical Warfare, Signal, Subsistence, Industrial, Command and General Staff, L'Ecole de Guerre (France), Army War College.

Navy: Communications (radio), Naval War College.

This is a most imposing list of institutions of learning, and it must be admitted that the Marine Corps has at its disposal a military school system unequalled anywhere else in the world. To this must be added the school

of experience, which has been available to the Marines to an extent that must satisfy the cravings of the most ardent seeker after the practical training of active service.

But schooling and policing Central-American countries do not necessarily produce an organization adequately prepared and designed to meet the requirements of the war-time mission. For this purpose, one must have training of and with the forces involved, and an organization suited to the probable employment. The Marine Corps is organized, broadly speaking, into two expeditionary forces, the East Coast, based at Quantico, Virginia, and the West Coast, based at San Diego, California. These two forces, when not occupied by emergency peace-time operations beyond our continental boundaries, are engaged to a limited extent in the training such forces require for their specialty, the seizure and defense of advance bases.

Let us turn now to the other side of the picture, the naval. In war, the Navy's great task is to gain and exercise command of the sea in the theater of operations. Underlying all of the operations of the fleet in the execution of this task is the question of bases; gaining and holding our own bases, and denying bases to the enemy. When the theater of operations lies beyond the usable range of our prepared bases, the seizure of new bases becomes an unavoidable preliminary to the fleet battle by which alone command of the sea may be assured. Further, in major base-seizure operations, there may be necessary the preliminary gaining of a succession of small bases, advanced bases, from which the fleet or portions of it may operate in furtherance of the larger mission. In short, where a maritime nation goes to war without prepared bases, the seizure of advanced fleet bases becomes immediately of pressing importance. Is the Navy organized, trained, and prepared for the difficult task of seizing bases for its own use?

It will be interesting to examine certain of the naval aspects of base seizure. Experience has shown that the first essential to successful base-seizure operations is local command of the sea. Without such command, the operations against the intended land area cannot be successful. It was lack of this local command that resulted in the Battle of Lissa, important because it was the first battle between fleets of armored vessels. It was to gain this command that the Battle of Tsushima was fought. It was loss of this command of the local seas that forced the British out of the Mediterranean, leaving their Neapolitan allies to face Napoleon on shore, unsupported by the British fleet.

One cannot state in general terms what may be required to meet all situations under this preliminary condition. The operations required may be against submarines, air forces operating from floating or shore bases, and surface craft. It is a task, however, for which the Navy must be prepared. One German submarine reported to be in the vicinity of the Gallipoli peninsula during the Gallipoli campaign drove all the large British ships to cover for days, and left the British Army without naval support. Had the situation on shore been critical at that time, the whole campaign might have ended disastrously then.

The Navy's next big task is to land the assaulting force, the marines. The picture that comes to mind is a fleet of boats making rapidly for a beach, the water cut on all sides by zipping bullets, the air filled with flying fragments of shell, and clouds of deadly gases, some of the latter perhaps invisible. But this is not all. There are guns to be landed, ammunition, tanks, radio sets, food, and innumerable articles of supply. And there may be surf to be passed, and long stretches of shallow water, and submerged wire entanglements. In short, mere boats will not suffice; yet the Navy must land the troops and their paraphernalia.

When the troops reach dry land, their work has just begun. Now they must advance and secure the beach, penetrate inland, gain a beach head, spread farther and farther, until the offshore waters are made secure and space is gained for consolidation of forces and their organization for the main attack. Every foot of this advance must be fought for, and the indispensable adjunct to the advance of infantry is the artillery. The Navy must be the marines' artillery until such time as the marines' own artillery can be landed and brought into action. The attack is now in the stage which inspired the late General Cole's motto in his article in the November 1929 issue of the PROCEEDINGS *Aut vincere aut mori*, either conquer or die. And the deciding factor may be the Navy's artillery fire.

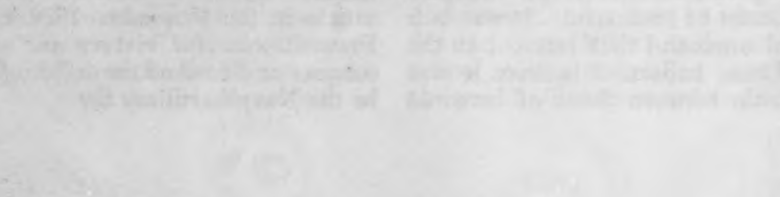
What is needed for this supporting fire? Guns that will deliver a hail of bursting shell on the heads of defending troops; guns that can blast out and destroy shore batteries; guns that can reach far inland and destroy lines of communication; guns that can drop their shells almost vertically behind protecting rises of ground; high-explosive shells; shells with supersensitive fuses; bombs with similar characteristics that can be dropped from aircraft; and with it all, a sureness and accuracy of control and facility of communication that will give to the marines the assurance of support when and where the lack of support means disaster.

Naval vessels are not designed for this type of action, nor are naval guns and ammunition. The British found it necessary to build special types and to rebuild other vessels to meet their needs. What better use could be made of vessels no longer able to keep their place in, or in support of, the battle line than to reserve them for such use, equip them for experimentation? Never since the beginning of naval history has a naval commander had so many vessels at his disposal that he could afford to detach as many as he desired from his fleet for such secondary purposes. Always concessions have been made to necessity, makeshifts have been resorted to, and operations against shore bases have proved costly and frequently disastrous. If the same thought, care, and degree of preparation were devoted to the operations for the seizure of a base that are devoted to the preparation of a fleet for battle, the base operations would not fail, and time and lives would be saved.

One more major task remains for the Navy. It must serve as a floating base for the troops ashore. It must provide supplies of men and material, food, water, fuel, ammunition, and the thousand and one items that will be required. Everything must be transported ashore, landing places constructed, and shelter provided for. The needs of even a small army which is self-supporting are staggering, and the water transportation involved in the constant flow of supplies ashore is no mean problem. Ships carry boats, but these boats, in fact all the small boats in the Navy, would be only a "drop in the bucket," compared to our needs.

Last comes the care of the wounded. Hospital ships are not built overnight, and the need will be great. Oddly enough, hospitalization afloat is something which was either overlooked or disregarded when forces were assembled for the first attack on Gallipoli. In a very short time every vessel offshore was loaded to capacity with wounded, and men lay for hours on deck without the necessary medical care and attention.

It is the mission of the Marine Corps to "support the fleet." But likewise it will be the mission of some part of the fleet to support the Marine Corps landing force. When two forces of different arms have a mutual task, there must be mutual understanding, common thought, study, preparation, and training. With these, if the time ever comes when the Navy needs more and better bases, the Navy and the marines can take and hold them.



CRUISER QUOTAS AT THE 1935 CONFERENCE

By Lieutenant Franklin G. Percival, U. S. Navy (Retired)

OUR delegation at the Geneva conference and again at the London conference was severely handicapped by our failure to build cruisers up to the 5-5-3 ratio before attempting to negotiate a treaty. It was in the unfortunate position of having to entreat others to stop building while we caught up with them. Japan, fully aware of our disadvantage, used it to exact further concessions from us. As a result, that power now has a ratio of approximately seven to ten in the classes which were not previously limited at the Washington conference, instead of the six to ten ratio which we made such staggering sacrifices to establish at Washington in 1922. If we go to the 1935 conference without our full quota of cruisers, we may expect to have to make still further surrenders. Not only do we need more cruisers to round out our fleet, but we must have them before this next conference if we are to avoid further sacrifices which might be disastrous.

Aside from the chronic difficulty of getting appropriations, the chief obstacle to building up to the treaty limitations is the wide difference of opinion in the service as to the utility of 6-inch-gun cruisers. Every officer is convinced that we should build with a minimum of delay our full quota of 8-inch-gun cruisers. If service opinion were equally unanimous as to the advisability of building now our unexpended balance of 73,000 tons of 6-inch-gun cruisers, the objections in Congress to appropriating the necessary funds would be greatly reduced.

The testimony before the Senate committees regarding the London treaty indicated that nearly all experts agree that we could use advantageously a limited number of 6-inch-gun cruisers. The controversy was over whether we needed approximately 100,000 tons or approximately 140,000 tons in this category. If it could be shown that the situation of the 1935 conference will be so changed as to make it fairly certain that other powers, particularly England, will ask for more 8-inch and fewer 6-inch-gun cruisers, and that we will have no trouble in replacing our *Omahas* with 8-inch-gun cruisers if we so choose, expert opinion would then be practically unanimous that we should build promptly up to the treaty allowance of 6-inch-gun cruisers. A paper which calls attention to radical changes in the probable demands of other powers when we next face them across the conference table therefore seems especially timely and is accordingly submitted to the judgment of the service.

Predictions in general are risky things, but if three or four reasonable probabilities can be cited, any one of which will produce a certain situation, the forecast deserves attention. If, in addition, we can exert effective pressure to sway the course of events to produce that situation and are firmly resolved to do so, all reasonable doubt disappears and the prediction may serve as a possible basis for action.

Since England has been the power whose views on cruiser types clashed mostly with ours, this paper deals chiefly with probable changes in her aims at this next conference. She has, as we all know, based her post Washington naval policy on three interdependent efforts. One was to abolish the battleship; another was to hold the maximum allowed displacement of individual 6-inch-gun cruisers down below 7,500 tons; while the third was to limit severely the number of 8-inch-gun cruisers. If the British had succeeded in their efforts, the 8-inch-gun cruisers would have become the capital ships of the future and in the event of another war would have been kept concentrated just as battleships were in 1914-18.

All cruiser functions would then have been performed by small 6-inch-gun cruisers which would have been of little greater, if

as great, combat value as fast merchant vessels armed with a larger number of 6-inch guns. It must also be remembered that a decade ago the various navies were off on a mad race for cruiser speed. Had this continued, the ever-mounting speeds would have forced such sacrifices of protection that cruisers of 6,000 to 7,500 tons would have carried so little armor that their power of survival would have become even less than that of a large auxiliary cruiser with improvised protection. The naval value of the British mercantile marine would consequently have been so enhanced that paper parity would actually have meant an overwhelming preponderance of sea power for England. Such superiority over the second strongest navy has consistently been and probably still is her aim.

A change in British policy, although not in the aim of that policy, is due for several reasons. In the first place, England has begun to realize that, if the five treaty powers should agree to abolish the battleship, the most powerful warships in European waters would then be owned by Germany, Russia, Spain, and Turkey. This would produce a shift in relative strength which none of the leading navies would care to bring about. There is, furthermore, a growing appreciation of the rôles played by the capital ship in countering the airplane and in supplying certain elements necessary to a balanced fleet. The importance of the former rôle will continue to grow with improvements in antiaircraft fire.

A reason conclusive in itself is the firm stand taken on this issue at the London conference by both Japan and the United States. It should now be clear to all concerned that neither power will be so silly as to abandon this type. Furthermore, the fact that France is modernizing her existing capital ships and planning a division of super *Ersatz-Preussens* indicates a renewed appreciation of such vessels in that navy. Since any one of the five signatory nations could block this move which is now contrary to the interest of them all, we may say that England's effort to abolish the battleship has been definitely killed.

With the continuance of the battleship assured, 8-inch-gun cruisers will be free to attack commerce. The inevitable result will be that only the most powerful 8-inch-gun cruisers will be capable of defending commerce. The small 6-inch-gun cruisers advocated by England for the protection of trade routes would not only fail to afford that protection but would themselves be destroyed by the larger cruisers. Other powers can no more safeguard their commerce with 6-inch-gun cruisers than we can. Obviously then, all treaty navies must have a number of additional 8-inch-gun cruisers for the protection of certain vital lines of communication. Since the others now have no more use for 6-inch-gun cruisers than we do, it follows that in 1935 they will probably be asking for fewer 6-inch as well as for more 8-inch-gun cruisers.

The decline of the 6-inch-gun cruiser was further accelerated by the failure of the British at the London conference to hold the maximum displacement of this type down to some figure between 6,000 and 7,500 tons, as well as by the moderation of the craze for speed. The potential value of England's large, fast merchant vessels *as cruisers* was thereby greatly reduced; for, while an armed liner could face a very fast 6,000-ton light cruiser with confidence, it would be hopelessly outclassed by a stoutly protected and heavily armed 10,000-ton, 6-inch-gun cruiser of moderate speed. The second of England's three interdependent moves has therefore failed just as definitely as the first.

The advent of the *Ersatz-Preussen*, furthermore, marked a milestone in cruiser development. It indicated a definite end to the already moderating craze for speed and a renewed appreciation of the value of striking and resisting power aboard a vessel which is primarily a fighting ship, not a racing machine.

A shift of authoritative opinion in France which portends the construction of well-balanced cruisers by that power has been indicated in the following words:

> The leading admirals of the *Conseil Superieur*, Admirals Violette, Pirot, and others, are in favor of bona fide fighting ships, that is *capables d'encaisser*, capable of taking at the same time as giving. Ships of 14,000 tons at full load, mounting long-range guns of 8-inch bore, but at the same time so deficient in armor as to be vulnerable to the new 5-inch shells, appear to many as a faulty compromise. . . . It is now felt that that universal 10,000-ton Washington standard cruiser (thin skin, long-legged greyhound or weak-hearted boxer) has been a gross mistake. . . .
> (*Naval and Military Record*, 20 November, 1929)

The fact that our new 8-inch-gun cruisers have been delayed in order to give them

thicker armor speaks more eloquently than any words of the shifting naval opinion in this country. We may therefore expect to see well-balanced cruisers built in the future by the United States, France and Italy.

These well-balanced cruisers will completely outclass their flimsily protected predecessors. Such a situation has usually produced a fresh outburst of building. Since France and Italy have not agreed to limit their cruisers, they will be free to take advantage of this situation to improve their position relative to the three leading powers. It therefore seems probable that for the next few years the Mediterranean rivals will concentrate on building adequately protected 8-inch-gun cruisers. This construction will compel England and Japan to come to the next conference in 1935 demanding an increase in their 8-inch-gun cruiser allowance in order to maintain their position relative to the Mediterranean powers. This demand would harmonize beautifully with our desire to replace our *Omahas* with 8-inch-gun cruisers.

It is then manifest that England must ask for an increased allowance of 8-inch-gun cruisers, not only because of her own requirements for commerce protection and her natural desire for cruisers of the new and more powerful type, but also because of probable future building by France and Italy. Japan will be likely to take the same position. Thus the third British effort, their struggle to limit severely the number of 8-inch-gun cruisers, is doomed to failure. With all three of these interdependent moves clearly impossible, England's carefully laid plan for retaining first place among the world's navies has completely collapsed.

Although Britain's post-Washington naval policy has thus come to naught, she nevertheless has achieved the objective of that policy, which was to utilize her mercantile marine to insure continued predominance on the seas. Her triumph is due, not to any premeditated scheme, but to the arising of a situation the far-reaching effects of which nobody foresaw. This is the development of air forces afloat, which permits her large fast merchant vessels now to be utilized as aircraft carriers. They would probably be worth more as carriers than as auxiliary cruisers, even if it could be assured that they would be faced only by small 6-inch-gun cruisers.

As a result, England no longer needs to have the battleship abolished, to hold down the displacement of 6-inch-gun cruisers, or to limit severely the number of 8-inch-gun cruisers in order to reap a tremendous advantage from her superior merchant fleet. In short, not only have Britain's three interdependent moves definitely been thwarted, but the objective of these moves has been achieved by another and an unexpected means. Since the Admiralty is far too clever to try to ride a dead horse, especially when they already have been carried to their destination by another mount, we may expect to see them trot out one of a different color at the 1935 conference. It is likely that this new horse will closely resemble our own.

To the reasons already given for harmony between the aims of England and the United States at this next conference, the new situation created by the probable employment of merchant vessels as aircraft carriers adds another. Since these improvised carriers will probably have an even weaker gun defence against aircraft than the regular carriers, they must rely almost entirely upon other vessels for such defense. The backbone of this defense must inevitably be the battleships. So far as this duty is concerned, the continuance of the battleship is of even greater importance to the British than it is to us, because we have fewer potential carriers than they do. In view of the reasons already given, can there now be any serious doubt that England will be found standing shoulder to shoulder with us on the battleship issue in 1935?

There is still another reason for prospective Anglo-American harmony. Thanks to her fine merchant fleet and to her admirable system of naval bases, England now has that marked superiority over the second-strongest navy which has been her traditional aim. Due partly to this and partly to the improved relations between our two countries, as well as to the more serious situation developing in Europe, it is likely that future British policy will concern itself chiefly with navies other than ours. So far as these other navies are concerned, England has the same reasons for wishing to retain the battleship and to increase her allowance of 8-inch-gun cruisers that we do. We therefore have every reason to look for strong support from England on those points on which we formerly differed.

In the event, however, of some unforeseen happening which might cause a slight variation in British policy, it is well to remember that the United States will enter the 1935 conference with perfect freedom to ask for whatever type of cruiser it needs without regard to existing allowances, which run only to the end of 1936. To make assurance doubly sure on this point, Japan specifically reserved the right to reopen the subject of 8-inch-gun cruisers at the next conference. This means, of course, that we are equally free to reopen the subject and it does not necessarily follow that we will reopen it to our disadvantage.

We have it in our power to demand as many 8-inch-gun cruisers as we need and to refuse flatly to accept a large quota of 6-inch-gun cruisers which are unsuited to our *general* cruiser requirements and which, for that matter, are in the same degree unsuitable for any of the treaty powers. There is, however, like likelihood that we should have to put up a fight on this matter. If we should, the ease with which an opposing position could be shown to be untenable, makes it reasonably certain that our views would prevail. This reasonable certainty would be further strengthened if we entered the conference with our full quota of cruisers either built or under construction.

Our reasons for predicting a change in British policy may then be summed up as follows: The move to abolish the battleship will be dropped because such a move is no longer to the interest of any of the five treaty powers, while the objection of only a single power is necessary to block it. It may therefore be taken for granted that, in future wars, 8-inch-gun cruisers will be free to attack commerce. This means that the 6-inch-gun cruiser will be useless for the defense of trade and that more 8-inch-gun cruisers will be required for this purpose. The evolution of the new type of well-balanced 8-inch-gun cruiser will accelerate the building of such vessels by France and Italy, which will be another reason why England will be asking for more 8-inch-gun cruisers in 1935. The British, furthermore, will greatly modify their demands for 6-inch-gun cruisers, not only because such ships are now useless for the protection of trade, but also because their large, fast merchant vessels are now worth more as aircraft carriers than they would have been as auxiliary cruisers.

We therefore have every reason to believe that England not only will interpose no objection to our replacing our *Omahas* with 8-inch-gun cruisers, but also will heartily cooperate with our move to do so. Since she has been the one power to hold out for large numbers of 6-inch-gun cruisers, we may expect no opposition from other quarters. If some opposition, nevertheless, should develop, we have a perfect right to demand as many 8-inch-gun cruisers as we need and can flatly refuse to accept a larger quota of 6-inch-gun cruisers than we really want, a stand in which we will be warmly supported by a majority, if not all, of the treaty powers.

We may say, therefore, that we will receive substantial additions to our allowance of 8-inch-gun cruisers and that we need not worry about being compelled to build more than the 73,000 tons of 6-inch-gun cruisers required to bring us up to the treaty allowance. This is not the place to discuss the characteristics of these vessels. It is enough for the purpose of this paper to call attention to the fact that even the opponents of the treaty agreed that we could use to advantage approximately 100,000 tons of 6-inch-gun cruisers. Since this exceeds the tonnage under discussion by over one-third, does not the new situation eliminate all doubt on technical grounds as to the advisability of building up to our maximum allowance in this category?

With our full quota of cruisers either completed or under construction we would be able to resist the further encroachments on our position which will doubtlessly be attempted at the 1935 conference. Without that quota, we must expect further losses in relative strength which would jeopardize our security and might even encourage attacks upon us.

Since there is now no technical objection to building the cruisers, since we need them to round out our fleet, and since we must have them before this next conference, should not service opinion recognize the changed situation and rally behind the move to obtain these cruisers?

THE DISTRIBUTION OF SHOTS WITHIN A SALVO

By Lieutenant Commander Leighton Wood, U. S. Navy

IN THE January, 1929, issue of the Proceedings, Commander G. L. Schuyler, U. S. Navy, published an article on the "Distribution of Shots in Long-Range Salvos" in which he brought up the question of the unsymmetrical distribution to be expected when firing at ranges where the effect of the flight characteristics becomes the determining dispersion effect rather than the velocity variation. He placed in comparison the pure probability curve, Fig. 1, and the unsymmetrical distribution curve of Fig. 2, using as his three centers the "mean" or the M.P.I. commonly used in dealing with positions of the shots of a salvo, the median," which has equal numbers of points each side of it, and the "mode," or the point on each side of which the density of points symmetrically decreases.

The general laws of accidental errors upon which the probability curve is based are:

(a) That small errors are more frequent than large ones.

(b) That positive and negative errors of the same size are about equal in number.

(c) That very large accidental errors do not occur.

The present vogue for statistical truths has caused a loss of faith in the pure probability curve as applied to many measurable phenomena. And now, apparently, the application of the laws of probability to the effectiveness and control of gunfire is going the way of mortality tables and industrial statistics.

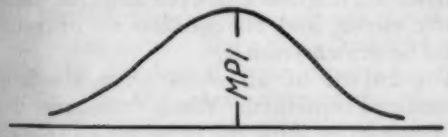


FIG. 1

Commander Schuyler takes exception to the application of the second law for long range firing on the grounds that:

> Shots tumble short rather than over, and it is easier to imagine something going wrong with the flight of a projectile and causing a certain decrease in range, than it is to imagine an analogous effect causing an equal increase in range. The part of the dispersion caused by flight characteristics is therefore not safely assumed to be of symmetrical distribution. It may be expected generally to show a preponderance of shorts.

And he draws as his conclusions:

(a) Spotters should attempt to spot the mode to the point of aim.

(b) Since the true mode is not well indicated by the intervals between impacts in any one salvo; the spotter should spot the median.

(c) As an extension, the median should be used in analyzing proving ground and target practice results.

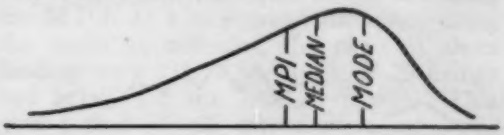


FIG. 2

Many officers, in analyzing gunnery performances at long ranges, have felt that even though the pure probability equation might be applicable to the firing of a single gun, it could not be safely applied to analyses of salvo firings. It was felt that in salvo firing the minor variations of conditions between guns were enough to prevent a single probability curve from being used, requiring a series of probability curves, one for each gun of the battery. Consequently, it was felt that the result of combining these several probability curves would not be a simple curve. This belief is largely based upon the assumption that one gun will shoot consistently short with respect to the other guns of the battery, one will shoot consistently over,

and the remaining guns will shoot between these two. Of course it should be expected that the probability curves of the various guns would overlap, and, since an individual shot may land anywhere within its own probability curve, there would be occasions where the impact from the gun determining the short probability curve would not necessarily be the short impact of the salvo. The individual curves of the guns of a battery would be expected to look something like Fig. 3, and the resulting curve something like Fig. 4.

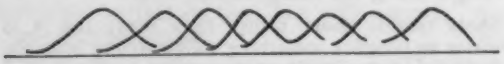


FIG. 3

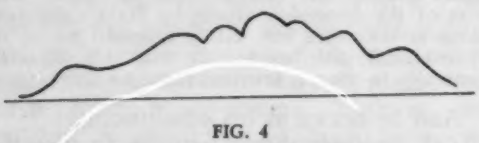


FIG. 4

Those who favored an unsymmetrical distribution and also felt that the limiting pattern size was determined by individual guns would favor Fig. 5, and the composite curve of Fig. 6.

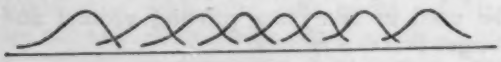


FIG. 5

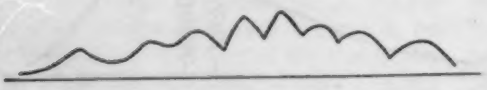


FIG. 6

Certain officers have also felt that there is a tendency of the shots to bunch towards the over end of a pattern and to straggle out towards the short end. This means an unsymmetrical distribution with the point of greatest density towards the over end of the pattern. This feeling is so strong that the spotting doctrine of one ship of the battle fleet requires the spotter to disregard the two short shots in each salvo and spot the estimated M.P.I. of the remaining shots to the target. "Wild" shots, of course, are disregarded. This spotting doctrine intentionally keeps the M.P.I. short of the target. It is an attempt to spot an unsymmetrical distribution of shots in order to get the greatest density within the hitting space.

Consequently, there are four distinct points of uncertainty in connection with the distribution of shots within a salvo. They are:

(a) Do the shots form a symmetrical or an unsymmetrical curve?

(b) Do the shots follow any simple curve, either symmetrical or unsymmetrical?

(c) If the shots follow an unsymmetrical curve what is the extent of the lack of symmetry? Or is the distance between the M.P.I. and the mode great enough to justify the attempt by the spotter to control it?

(d) If the shots follow a series of symmetrical or unsymmetrical curves, is it possible to use this fact to decrease the dispersion?

In order to study the relationship of In (b), that positive and negative errors of the same size are about equal in number, to the distribution of shots in long range salvos I plotted the long range battle practices of the battleships of the battle fleet for 1928-29. The first ship plotted gave a curve similar to Fig. 7.

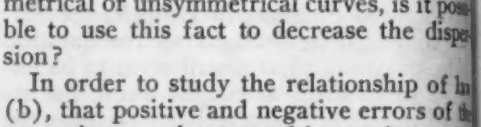


FIG. 7

The M.P.I. median and mode are shown quite clearly. Secondary peaks are also present. Their height shows that they were undoubtedly made by single guns, one gun firing consistently short and one consistently over with respect to the remaining guns of the battery. The valleys joining the secondary peaks to the main curve were much more clearly emphasized than had been anticipated. However, in a single practice any distribution might occur, even in a true probability curve, and no conclusions of value could be drawn from it.

The curves of all ships were similarly plotted and combined. While each curve did not necessarily show the pronounced characteristics of the first, the composite curve, Fig. 8, demonstrates the presence of the mode and of the secondary peaks.

In order to check these results still further the long-range battle firings for 1929-30 were plotted and combined. The results were found to be in agreement with those found for the previous year. In both of these composite curves the unsymmetrical distribution

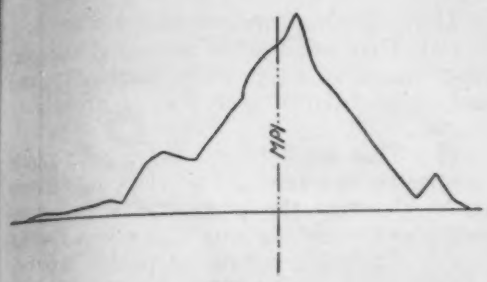


FIG. 8

and the secondary peaks were present. Of course the variation in pattern size between different ships and between different salvos from the same ship has a tendency to level these peaks. However, it is seen that the greatest density of impact is clearly beyond the M.P.I. and that the shots of a salvo do fall in an unsymmetrical composite curve, following the general type of Fig. 6.

Accepting the fact that they do fall in an unsymmetrical curve, is the lack of symmetry great enough with respect to the probable pattern size to assist the spotter in controlling fire? Unless this lack of symmetry is great enough for the spotter to be able to identify the mode or the median, this knowledge of an unsymmetrical distribution is purely academic as far as the spotter is concerned.

Looking back on my own experiences as a spotter, as well as discussing the question of spotting with main battery spotters in the battle fleet today, I am convinced that spotters make no effort, conscious or unconscious, to evaluate the positions of the various impacts within a salvo and to determine the M.P.I. We talk gliby of instinctively determining the M.P.I. and estimating its distance from the center of the hitting space. At long ranges, in spotting from the firing ship, the determining elements are the short shots in the salvo. Since these land first, the secondary splashes of these impacts are frequently high enough to obscure the plumes of later shots. Consequently, the splashes of the far shots of a salvo may never be seen at all. If the spotter is fortunate enough to be able to observe the plume of each shot in the salvo he still can only form a general impression of the location of the various shots with respect to each other, and consequently, of the M.P.I. What the spotter actually does, as Schuyler suggests, is to make a rough estimate of the center of the salvo, the median, and estimate the error of this point in yards or ratios of pattern sizes. The spotter's problem is still further complicated by the lack of uniformity of appearance, both in range and deflection, of consecutive salvos, and by the possibility of a shot being wild enough to be definitely recognized as such. The problem of "double bunching," where the shots of a salvo fall in two well-defined groups, presents trouble of its own to the spotter but bears no relationship to the present discussion.

The plane spotter, on the other hand, can observe the location of every shot in every salvo. As a consequence, he is in a better position to observe and evaluate either wild shots or abnormal distributions. He can arrive at a closer approximation of the location of either the M.P.I. or the median and of its distance to the center of the hitting space. Under certain conditions he might even be able to determine the location of the mode, and spot it to the center of the hitting space.

The distance between the mode, median, and M.P.I. is small and it is immaterial which of the three the spotter actually uses. Since the median is much easier to recognize it seems logical for the spotter to use this point.

However, a possible element of control does enter here. In equal areas, one using the M.P.I. as a center and the other using the mode as a center, the ratio of shots landing were 1:1.15 for the 1928-29 firings and 1:1.30 for the 1929-30 firings. This means that if all salvos were correctly placed, a down control spot by all ships, to shift the mode to the center of the hitting space instead of the M.P.I. would have resulted in 15 per cent more direct hits in 1928-29 and 30 per cent more hits in 1929-30. In equal areas for an effective zone the ratios are practically the same. This resulted from the over limit of the effective zone, using the mode as a center, corresponding closely with the valley between the main and over secondary peak.

The fourth point of uncertainty, the possibility of determining the guns causing the secondary peaks and applying individual corrections to them to decrease dispersion, is still a mooted point. If we can determine that the secondary peaks are consistently caused by one or more individual guns, and if we can determine which guns are

forming these secondary peaks the problem becomes simple. The best evidence supporting this belief at the present time is largely analogy from secondary battery fire. In secondary battery fire, where the salvos are fired in groups with no change of setting, the similarity between consecutive salvos is striking. This similarity is so definite that it can only be caused by the shots from individual guns taking the same position with respect to the other shots until a change of setting causes the guns to take a new alignment with respect to each other, and, consequently, a new distribution of shots. This new distribution continues until a later change of setting again alters the relationship between the guns. The only direct evidence from main battery firings that I have been able to obtain was in one practice where the impact from an individual gun was definitely isolated in each salvo. The shell from this gun was the short shot four times, the second shot twice, and the third shot once. The consistent location of the impact of the shells from this gun at the short end of the salvo was enough to justify the belief that an arbitrary correction applied to this gun would have brought it nearer the M.P.I. and consequently would have materially reduced the dispersion of the battery.

The following conclusions are offered:

(a) That shells from an individual g distribute themselves unsymmetrically, a not in accordance with a pure probabil curve.

(b) That shells from a battery distribu themselves in a series of overlapping unsy metrical curves, the final curve being a com posite unsymmetrical one with several peak

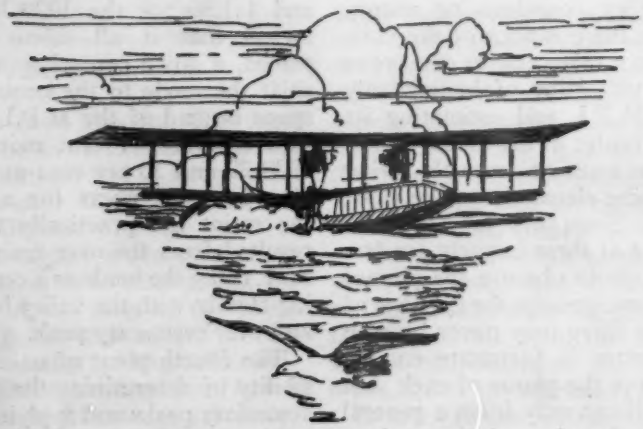
(c) That the individual peaks are pr marily determined by the impacts from i dividual guns.

(d) That the spotters from both the fi ing ship and aircraft spot the median rathe than the M.P.I.

(e) That the distance between the M.P.I median and mode is negligible as far as th spotter is concerned, and is probably un recognizable by the spotter.

(f) That the possible gain in direct hi through a control ballistic compensating fo the distance between the mode and th M.P.I. is enough to justify the use of such ballistic.

(g) That as the normal position of th impacts from individual guns within th salvo are determined, corrections applied t the individual guns to bring their norma position of impact closer together will re duce dispersion.



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FLEET FLAGSHIP TAKES LAST VIEW OF NEW YORK FOR A YEAR

An unusual picture of the U.S.S. *Texas* as she passed Governor's Island.

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NEW YORK GETS LAST GLIMPSE OF FLEET FLAGSHIP

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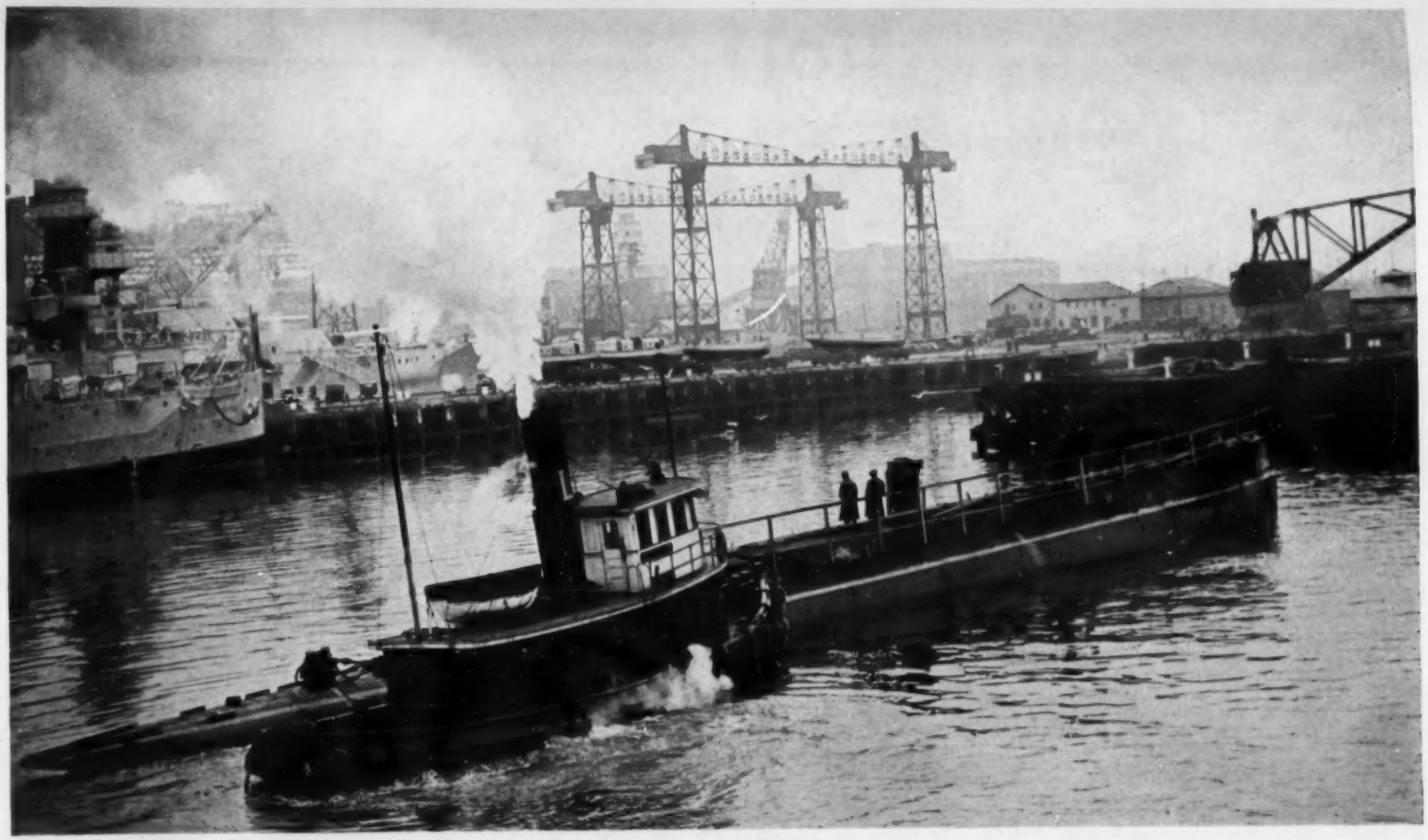
NEW YORK GETS LAST GLIMPSE OF FLEET FLAGSHIP



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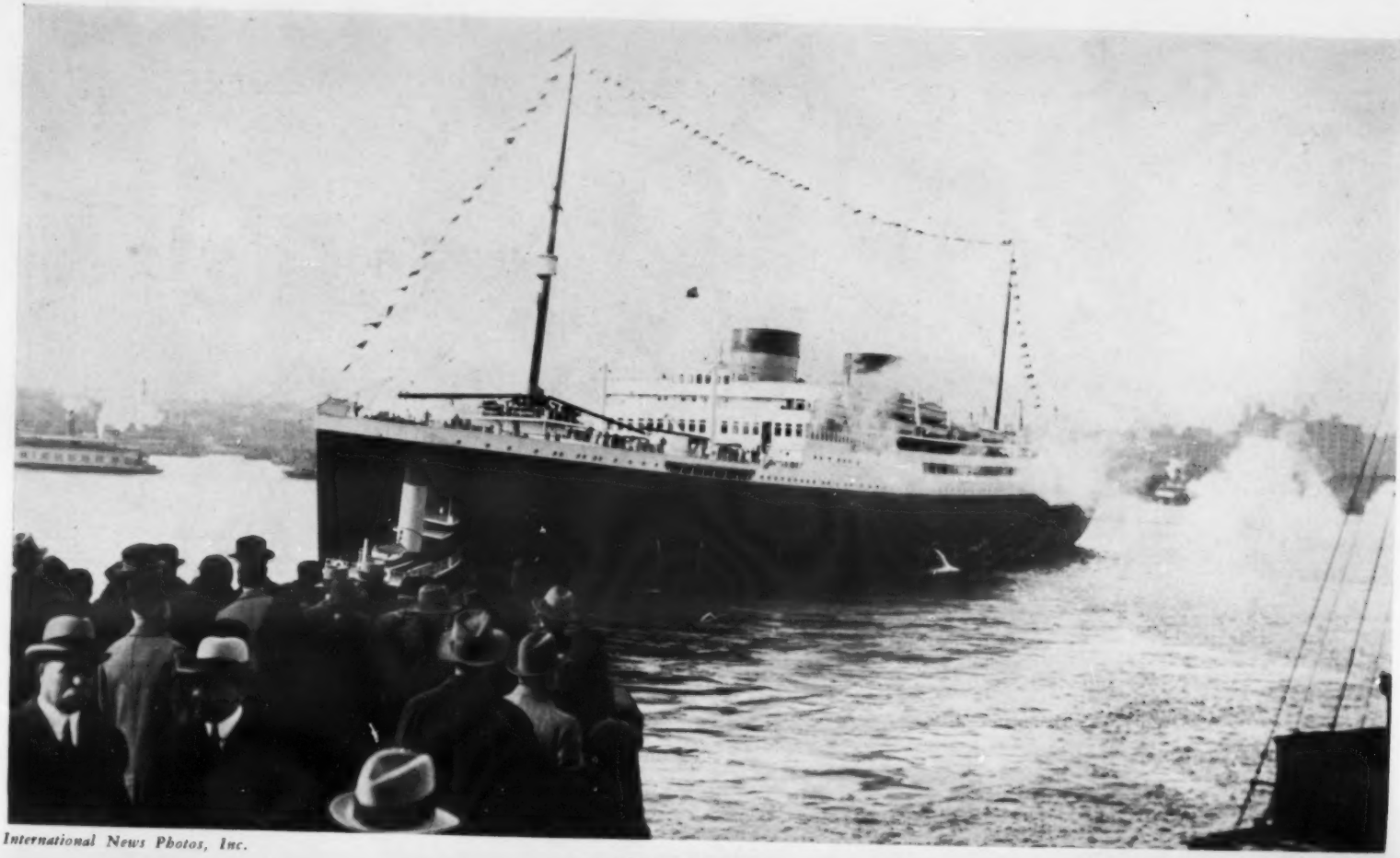
THE *NAUTILUS* (FORMER NAVY *O-12*), SIR HUBERT WILKINS' NORTH POLE SUBMARINE

The tugboat is pushing the *Nautilus* from the Philadelphia Navy Yard to the Mathis shipbuilding yard in Camden, New Jersey, where the submarine will be given the finishing touches preparatory to the arctic cruise to the North Pole scheduled for next summer. Five members of the Wilkins' crew made this first "voyage."



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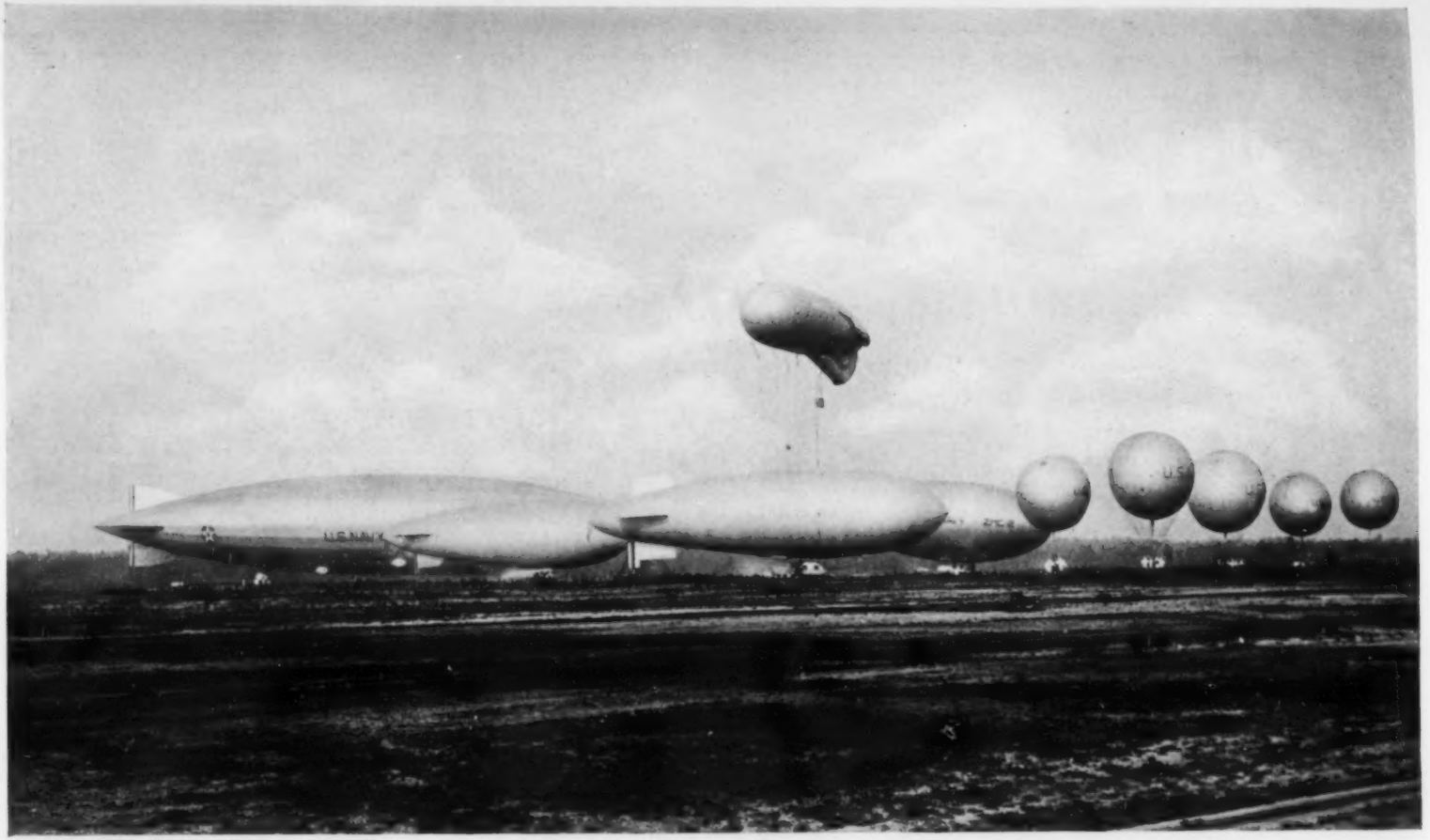

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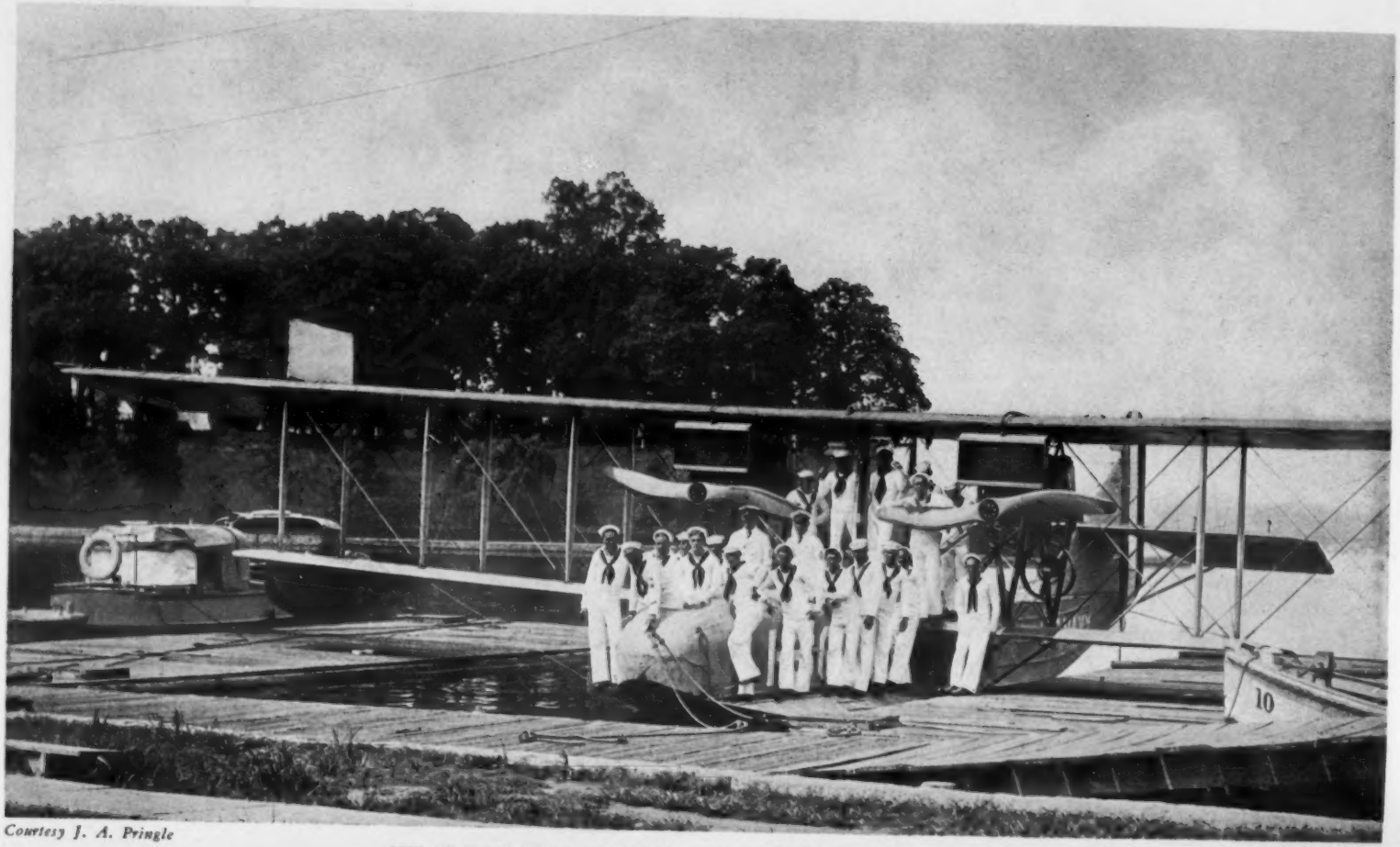
THE NAVY'S GAS BAGS HOLD A GET-TOGETHER

Four dirigibles, five free balloons, and one captive "sausage," are shown during a gas-bag carnival held at the Naval Air Station, Lakehurst.



Courtesy J. A. Pringle

ONE OF THE EARLIER TRAINING PLANES AT THE NAVAL ACADEMY

Courtesy J. A. Pringle

ONE OF THE EARLIER TRAINING PLANES AT THE NAVAL ACADEMY

Courtesy Navy Yard, Portsmouth, New Hampshire

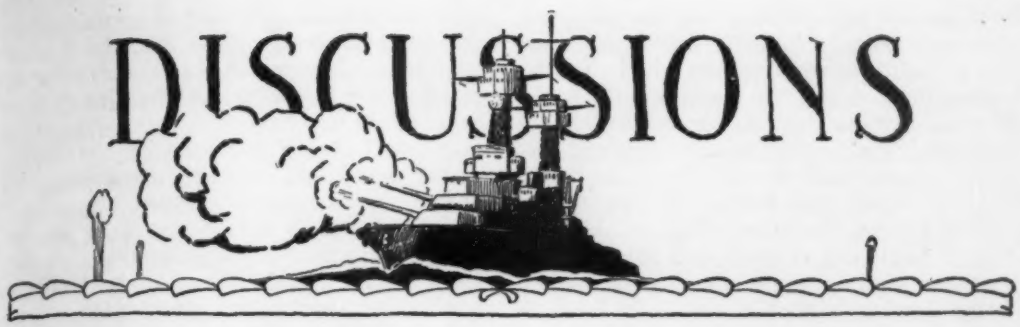
SAILING DINGHY—GAFF-HEADED RIG

(See page 427)

Courtesy Navy Yard, Portsmouth, New Hampshire

SAILING DINGHY—JIB-HEADED RIG
(See page 427)

DISCUSSIONS



SAILING DINGHY—JIB-HEADED RIG
(See page 427)

Courtesy Navy Yard, Portsmouth, New Hampshire

On a Light Cruiser During the War

(See page 33, January, 1931, PROCEEDINGS)

CAPTAIN H. E. COOK, U. S. NAVY.—It is not stated whether this article is a translation or written in English.

This article is of interest, as far too few personal narratives of naval operations on the German side during the World War have found their way into print in the English language. Consequently every one that does throws light or furnishes additional information regarding the operations mentioned.

Captain Koblinski apparently served on the same ship from May, 1914, throughout the war. He does not state the name of that ship but simply states that she is one of the *Bremen* class. It is apparent that the ship was the *München*. This may be verified by a comparison of the casualties encountered in the night action at Jutland with the statement in the official German history.

The full-page picture facing page 33 bears the caption "German Cruisers at Sea, 1918." The ships showing in the picture evidently are the larger type of destroyer. The ships are indistinct in the picture but Germany did not possess that number of two funnel cruisers and the old two-funnel cruisers had long ram bows.

The author states that whenever the fleet attacked the English coast his ship accompanied it, but it is not apparent that this small light cruiser accompanied the battle cruisers in any of their operations against the English coast. Probably they were stationed with the supporting battleships.

The author states that his ship weighed anchor on the evening of May 15, 1916, and took position in the screen of the battle fleet, prior to the Battle of Skagerrak. As the battle took place sixteen days later, it does not seem probable that this cruiser remained in screen formation during this time.

The battle station of his ship which was in Scouting Division 4 is described as abreast the Second Battle Squadron in the rear. This is confirmed by other accounts, and is an astonishing battle station for a light cruiser division in a fleet so unbalanced in this important type. It is to be regretted that Captain von Koblinski's battle station was below deck and that he was unable to observe and did not describe the remarkable tactical maneuvers of Scouting Division 4 throughout the Battle of Jutland. There was apparently a misconception of the mission of light cruisers in action. It seems that this division countermarched and changed course with the battleships. There was apparently no real effort at screening during the action.

The author in describing the first of the night actions with enemy cruisers states that he suddenly saw two or four ships to starboard steaming on a parallel course. These he took for German light cruisers but later recognized as English. He states further that the enemy had been the second light cruiser squadron of the *Southampton* class. He states that this action occurred about nine o'clock. Apparently these times are German times and this, therefore, was about eight o'clock Greenwich time. This corresponds with both the British and German official accounts of the action about 8:17 between Scouting Division 4 and the Third Light Cruiser Squadron, composed of the *Falmouth, Yarmouth, Birkenhead,* and *Gloucester,* in which action *München* was hit twice. The statement that these ships were sighted to starboard on a parallel course is remarkable and evidently in error.

EDITOR'S NOTE: The article was received from Captain von Koblinski in English.

Both British and German diagrams at about that time seem to indicate that just before this action Scouting Division 4 had changed course to port but not sufficiently to bring an enemy on the starboard bow. In this action, the Third Light Cruiser Squadron was fulfilling very well the mission of a screen. Had the service of information served as well as the service of security, and had the British battle line continued in formation at that time, serious results would have resulted to the German battle line.

The account of the later action with the Second Light Cruiser Squadron is interesting. It is a matter of regret that it is not in as much detail as a number of British personal narratives.

The latter part of the article is given to an account of the torpedoing of the *München* following a sortie against the English coast on October 9, 1916.

Nowhere can I find in any other account mention of the torpedoing by a British submarine of a German cruiser at that time. Admiral Jellicoe in the *Grand Fleet* states that on October 7 the battle cruiser fleet left Scapa and swept toward the Naze, and that on October 8 the Second Battle Squadron, the Second Cruiser Squadron, and some destroyers left Scapa to cruise to the eastward returning on the tenth.

Admiral Scheer in his book after describing the expedition of August 18, mentions planning a similar enterprise for the beginning of September and states that at the beginning of October obstacles were met in the resumption of submarine warfare. He next mentions that on October 10 the fleet advanced to the center of the North Sea, and makes a statement, "There was no encounter with the enemy."

It is a matter of regret that this German account like others, especially the rather fantastic account of Jutland attributed to Count Luckner, cannot be verified by official reports. The discrepancies render it of rather doubtful historical value.

Staff Organization Afloat

(See page 1113, December, 1930, Proceedings)

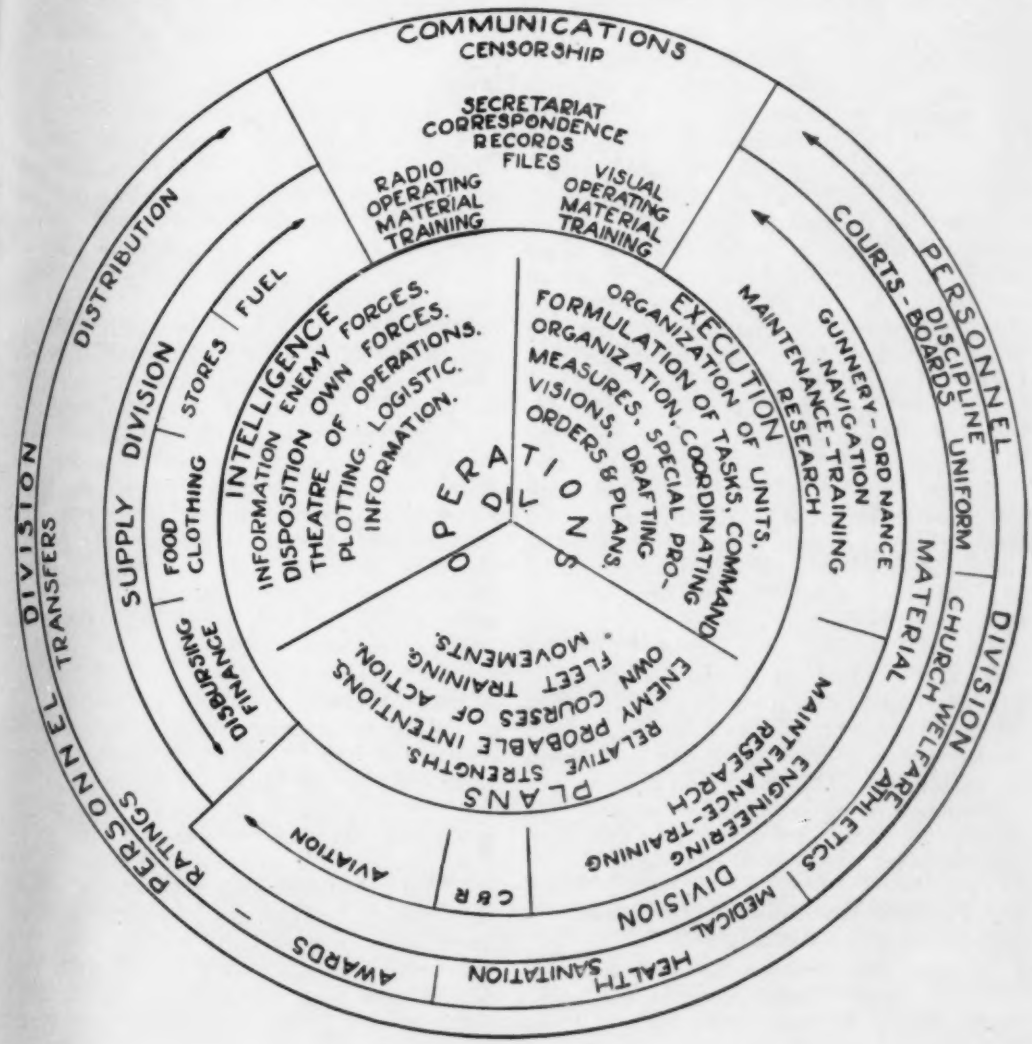
Lieutenant Walter C. Ansel, U. S. Navy.—As Lieutenant Commander Carney says, "Very little of practical value has been published on the subject" of naval staff work. A study of the subject by the junior class at the War College last year aroused considerable interest. Discussion would probably better come from an officer with staff experience; however, a few of the questions encountered in the War College study may have value.

It was found that most of the reference works were based on Army practices; much of it was, of course, of German origin. Although the staff needs of a fleet and an army in the field differ greatly, yet we can learn much from the Army. Their thought and consequent organization seem to be of longer standing and of a much more definite and standard character. They separate their staff functions under two heads, administration and operations. Lieutenant Commander Carney speaks of the two functions, tactical control, and administrative control, as existing in our naval staffs. Presumably these parallel the Army separations mentioned above. But it is not believed that the relative importance of operations has been sufficiently stressed in the Navy to take care of war work. The staff manuals of our afloat units seem to indicate that the greater part of the staff work consists in making peace-time administrative provisions to satisfy our crowded competitive schedules and our great amount of afloat maintenance. The composition of the staffs and the designations of its members appear to indicate that the staffs just grew as technical needs dictated. A staff engineer was detailed, then, perhaps, a gunnery expert, a radioman, a constructor, and finally an aviator. And all of them carry these administrative designations. Of course, all of them are necessary, but there seems to be very haphazard provision for the fleet's prime function—*War Operation*. We seem to have a hit or miss system, certainly not a standard one. When a short fleet concentration or other problem necessitates some detailed planning, an operations staff is whacked up and it takes care of the situation for the moment. I do not speak from exact knowledge but from appearances. Very probably I lack information on the inner workings of staffs but certainly their manuals should give some inkling of their procedure. I remember one which detailed each yeoman to a radiator-cleaning station in the flag office but failed to name an operations officer.

Several years ago the Proceedings published an article by Lieutenant H. J. Wright in which he suggested the organization of the

operations section of a naval staff to conform to the parts of the estimate of the situation form. Suppose we create an operations section and divide it into three parts; intelligence, plans, and execution. There must be intelligence of the enemy and of our own forces on which to base operations; knowledge of what is to act and what is to be acted against. So knowledge would be collected; its utilization would come in planning. The forces would be set against each other, estimated as to their capabilities and a plan of operation evolved. Then the plan remains to be fitted to the forces available and disseminated to those forces. These functions would come under execution. Adapting these divisions to the estimate form we see that, intelligence corresponds somewhat to "relative strengths of opposing forces"; plans, to "enemy probable intentions" plus "courses of action open to own forces"; execution, to "auxiliary decisions." Perhaps a more workable division might be to cut the work of intelligence after the subhead "own forces," leaving the comparison of strengths and conclusions as to their relative strength with plans.

Lieutenant Commander Carney says, " . . . it would be impossible for an officer to be assigned to one section only. Overlapping of duties is inherent in naval staff work and must be accepted . . . ," and further, "In any case it will become apparent that the lines of demarcation between the staff sec-



tions, as such, virtually disappear; this is *conclusive proof* that sharply defined staff sections are utterly impossible, and that overlap is essential." I fail to see wherein the conclusive proof lies. Anyone familiar with life aboard ship will grant that a person cannot get off in an air-tight compartment, free from all outside contacts, and work to any good effect. But it is difficult to see how the free interchange of ideas and co-operation can be an excuse for loose organization. Certainly in an extended operation such as a fleet movement across the Pacific a number of officers would be doing operations duties only. It would be physically impossible for them to do anything more. If in peace time the limited operational functions meet, and if the limited number of officers available requires doubling up of duties, the staffs can at least be uniformly organized by chart or pamphlet so that the paramountcy of operations, as a distinct function, is clearly established. Then when war comes, additional officers would simply fall into the minor billets already provided.

It is often difficult to determine what an organization chart is intended to define. It may show simply, cognizance, or it may also have mixed in with this, lines of authority, relation of different functions, or even, the flow of work. When these ideas are confused in one diagram it is of little value as a guide. The usual block and line chart is not very well suited to setting forth anything but a single one of the above mentioned divisions. Neither is it suited for indicating the relative importance of divisions. An Army manual uses a system of concentric rings, cut into segments, that can perhaps be adapted to our uses. The idea is to indicate the importance and amount of work in each division by its area, and to indicate its relationship to other divisions by its position. The boundaries of a division show to which other divisions it is as a whole related. Radial dividing lines which are not drawn through to the circles show that there is free interchange between adjoining sections. An attempt to draw up a chart after this manner for naval purposes is as shown.

A Practical Application of Navigation to Aircraft

(See page 1065, December, 1930, PROCEEDINGS)

LIEUTENANT COMMANDER GEORGE R. FAIRLAMB, U. S. Navy.—The flight of Lieutenant Connor and Roger Williams to Bermuda is unquestionably one of the outstanding and important air navigation flights in the history of aviation. That it has received no great amount of interest by the general public is quite understandable, in view of past and current accomplishments along the same line. Making a perfect landfall on time and in dangerously low visibility is quite different from doing the same thing in good visibility and marked the true excellence of the navigation and piloting. The importance of the flight lay in sole reliance on dead reckoning combined with astronomical observations, in accumulating additional evidence that such navigation can be accurately done, in adding another feather to the cap of experience. A noteworthy accomplishment, a tribute to navigator and pilots, the flight can only be fully appreciated by those who have actually *navigated* aircraft rather than those who have just *flown* them. There is a large distinction. I personally wish to salute Lieutenant Connor for his skill and am glad that he published an account of his flight. His story is written mostly for the layman. I trust that he will come back in discussion and clear up several points of interest to all air navigators.

These are: the manner in which he determined his drift with such apparent confidence and accuracy yet with (apparently) no precision instrument or smoke bombs to aid him (except for the short night period); the type of magnetic compass used; how he determined his "position by observation" (the chart shows three such positions marked and at least one other is inferred); the type of octant used and comments on its accuracy; whether his lines of position were really obtained from single sights as inferred or were the result of a mean of several; his average error for sun line observations under favorable conditions.

Taking these points up in order, the device of painting drift lines on the empennage is an old one but has never appealed as being very accurate or thoroughly reliable. It is evident that the *Columbia* could not carry a sufficient stock of smoke bombs for day use and apparently this was why a simple telescope drift sight and base plate was not used. But in very light surface breezes I have noted as much as 5° to 6° drift that would have been impossible to detect without a good point of reference on the water

such as smoke. It is a matter of great interest as to what Lieutenant Connor thinks of the rather elementary scheme he apparently was forced to use and to what he attributes his success. Were the surface conditions at all times such that he was not called on to get drift "by guess and by God?" Would he recommend it as adequate for all conditions with an *experienced* navigator—an *inexperienced* navigator?

Our Navy patrol and scouting squadrons use smoke bombs and drift sights. In the former type we go frequently on extended flights, sometimes all day and part of the night, well offshore and out of sight of land. We feel that good navigation depends primarily on accurate and frequent drift determinations, secondarily on radiocompass fixes obtained when in range of shore compass stations (but these have to be accepted with caution) and finally on celestial observations (to be accepted with caution), all presupposing, of course, accurate air speed meters, good compasses that permit steering within a degree of the course, and careful piloting. A high percentage of smoke bomb failures is encountered (Bureau of Ordnance experts please note) and we frequently must rely on judgment and the seaman's eye. While quite satisfactory for our purposes it is subject to error. We can figure on about 3 to 5 per cent average error (that is, three to five miles out in deflection in a hundred-mile run) due to shifting winds, steering, etc. The problem becomes more difficult as soon as divergent courses are steered on naval missions, as compared with straightaway flight with a single objective and idea in the minds of the entire crew. We find occasionally an unexpected complete accuracy after a long flight for navigation purposes only, but even so we feel that this is a case where our small errors have canceled out to zero.

With respect to compasses one must infer that the *Columbia's* pilots used the earth inductor compass and that this was working sufficiently well to indicate a degree of divergence from the course. Was the standby magnetic compass aperiodic, and was it graduated to each single degree? Our experience is that the standard aircraft type graduated only to every fifth degree is deficient for accurate navigation. Invariably the earth inductor when it works (and it is a frail instrument) and the finely graduated side reading aperiodic compass give better results. Our confidence in the latter is unbounded.

The positions "by observation" noted on Lieutenant Connor's chart are believed to be misnomers. It is believed that he must have assumed these as *best* positions by careful judgment in using his sun lines and the two checks obtained on the steamers sighted. In one case he has apparently taken the intersection of a position line with his course, where in others it is assumed that he used his ground speed as a radius from his last best position and swung it to intersect the position line. The confidence with which a navigator can use his astronomical lines of positions and fixes is a function of (a), his average error of observation obtained over a preliminary training period by taking sights over known landmarks, and (b), the confidence he places on the accuracy of his own dead reckoning account. Happy and blessed is he who can invariably reconcile the two. For example, the navigator knows that his average personal error of observation will never exceed plus or minus ten miles. (This gives in effect a position line that is twenty miles in thickness.) He takes a string of sights and his line plots, say, twenty miles from its nearest point to his D.R. position. He is at once confronted with a nasty problem. Has drift and ground speed changed without having been noticed? Have the pilots been steering carelessly? In a word, is he to believe his sight or his dead reckoning, since, as they stand, they refuse to reconcile? In such a case he would have to check by taking several strings of sights in quick succession and watch the average plot or be tortured by uncertainty. Unless Lieutenant Connor has found a very exceptional octant, or has developed an exceedingly delicate touch and sense that has reduced his observational errors to zero, I am at a loss to account for the excellence of his lines with single sights, and would like to hear the inside story on this point. In short, what is his average error of observation under favorable conditions? If it is less than plus or minus five miles, to what extent does he attribute this to the instrument and to what extent to the "practice that makes perfect?"

I am of course discussing the problem from the standpoint of *accuracy*, and accuracy on the order that a 5 per cent error is

still too much. For practical purposes of going from one place to another, this error if not permitted to accumulate, and there is no reason why it should accumulate to a dangerous extent, will suffice in good visibility. The author's point that air navigation must be even more accurate than surface ship navigation is well taken and heartily concurred in. The fallacy that sloppy navigation of aircraft gets by and is of no consequence because of supposedly superior visibility is widespread. It is a dangerous generalization applicable sometimes and to some types of flying, but never to long overseas flights where the objective, be it ship or land, must be attained or inevitable disaster result. Due to surface haze, the average vision from aircraft is infinitely less than the layman ordinarily thinks. It exists both over land and sea, sometimes the horizontal visibility on clear sunshiny days being perhaps not over ten miles for prominent objects and five miles for smaller ones. The pilot of a homing airplane returning to its carrier, or coming in to its base with all landmarks shrouded in haze and mist, gets a justifiable thrill when his landfall turns up "on the nose." In the former instance when it doesn't, the thrill becomes a cold chill.

Where Do We Stand

(See page 40, January, 1931, PROCEEDINGS)

LIEUTENANT CARL J. LAMB, U. S. Naval Reserve.—Lieutenant Moore has thoroughly brought home to us a point of vital importance to the Navy and the country. It is the duty of all citizens and particularly of naval officers, to spike falsehoods, errors, and mistatements, and to forcefully disseminate the true facts about the country and its proper protection. There has been, for many years, a considerable amount of misrepresentation prevalent in the country about the Navy, its objects, and duties. This misrepresentation has been particularly misleading with respect to the cost of building and maintaining the Navy.

While all spoken and written misinformation has not been intentional or malicious, a considerable proportion has been. Although almost unbelievable, one of the most important of our American monthly marine magazines has published what amounts to a deliberate and sarcastic attack upon the Navy, Shipping Board, and Government, entitled "Sisters and Servants."

I am taking the liberty of answering Lieutenant Moore's two concluding questions, as follows:

The naval establishment in general and its officers in particular are not treating their fellow-citizens fairly in keeping them uninformed of the true facts about the Navy.

While there has been continuous evidence of improved coöperation between the Navy and reservists, patriotic societies, and public-spirited citizens since the war, coöperation could be much more complete, in the future, and particularly with the press and popular magazines.

It seems to me that evidence of full cooperation in this particular case would be to see copies of Lieutenant Moore's striking article sent out by the National Security League, appearing reprinted in the marine magazines, be sent to all divisions in the fleet and to all reserve units, and reprinted in whatever newspapers possible. Incidentally, all of us can help by trying to increase the circulation of the PROCEEDINGS among civilians.

PROFESSIONAL NOTES

JANUARY 2 TO FEBRUARY 1, 1931

COMMANDER D. B. BEARY, U. S. NAVY

LIEUTENANT COMMANDER D. C. RAMSEY, U. S. NAVY

AND

PROFESSOR HENRY BLUESTONE, U. S. NAVAL ACADEMY

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NAVAL CONSTRUCTION IN 1930

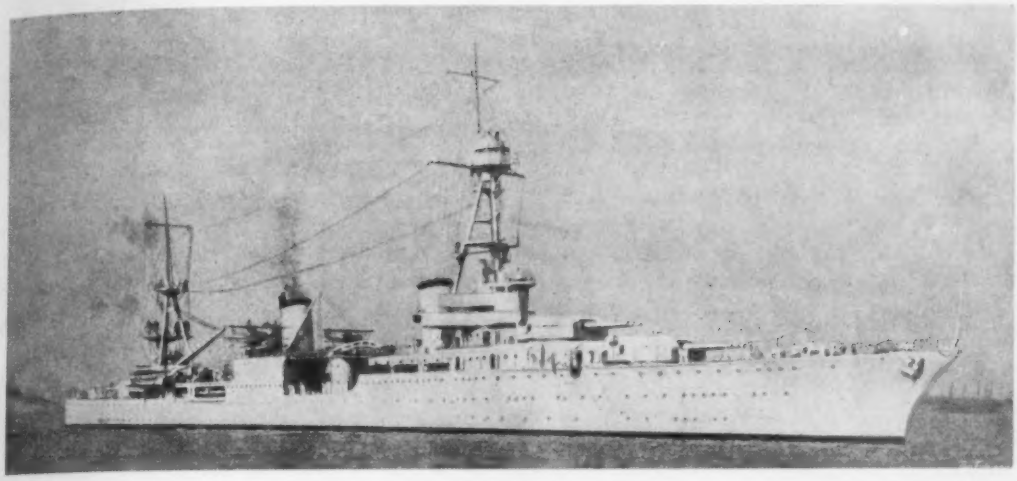
The Engineer, January 2, 1931.—In spite of diplomatic efforts to restrict the production of naval material, the past year was one of considerable activity in the shipyards and arsenals of every great maritime power save Great Britain. That was, perhaps, the inevitable result of a naval treaty which, while severely limiting British naval armaments, left the other signatory powers at liberty to continue the development of their fleets up to a certain maximum of strength, and from which the sea forces of the two leading continental powers were entirely excluded. This is not the place to comment on the London Naval Treaty, but it is difficult to escape the conclusion that we have been committed to a very one-sided bargain and have given away vital assets without receiving anything in return.

The British Empire

By a decision reached at the naval conference held in London during the early months of 1930, the replacement of capital ships authorized in the Washington treaty of 1922 has been postponed, and no vessels of this type will be laid down before 1936. As another naval conference is projected for that year, it is quite possible that the building of such ships will again be deferred. They may even be abolished by international agreement, though responsible naval opinion at home and abroad still regards the capital ship as an indispensable unit, and it is well known that several admiralties have prepared tentative designs for ships which, if built would eclipse the *Nelson* and *Rodney* in fighting power. For years to come, however, those two vessels must continue to rank as the strongest capital ships afloat, though it is eight years since their keels were laid. They constitute the spearhead of our battle fleet, which, in accordance with the London treaty, will shortly be reduced to fifteen units by the scrapping of five ships —the four *Iron Duke* battleships and the battle cruiser *Tiger.* With these ships will go the last 13.5-inch guns mounted in the British Navy, and henceforth 15-inch and 16-inch guns will comprise the main armament of the battle fleet. It is exceedingly doubtful whether guns of heavier caliber will ever be mounted afloat.

No aircraft carrier is either building or projected for the British Navy, though several vessels of this type are under construction abroad. The building of heavy cruisers has also ceased in this country, and upon the completion of the *Exeter,* now being prepared for sea at Devonport, we shall have no warship exceeding 6,500-tons displacement on the stocks. Had the five-year building program approved by Parliament in 1925 been duly executed, the British Empire, a year or two hence, would have possessed sixteen cruisers of 10,000 tons and seven of 8,400 tons, all armed with 8-inch guns. As it is, however, we are restricted to thirteen ships of 10,000 tons and two of 8,400 tons, mounting 116 guns of 8-inch caliber. On the other hand, the United States program provides for eighteen ships of 10,000 tons, mounting 164 guns of 8-inch caliber. The discrepancy between the heavy cruiser tonnage and gun power of the two fleets will thus be very marked, and is difficult to reconcile with the principle of "parity."

Dorsetshire and *Norfolk,* our last ships of the 10,000-ton *County* group, were both commissioned in the past year. Only in unimportant details do they differ from the *Kents* and *Londons,* which have been exhaustively described in *The Engineer.* In all these vessels the shaft horsepower has remained constant at 80,000, but improvements in the form of hull have given the later ships a slightly higher speed, and it is noteworthy that in every case the contract speed has been attained or surpassed without exceeding the specified s.hp. H.M.S. *York,* the first of the "B" class, was commissioned during the past year after very successful trials. She marks a welcome departure from the conventional and rather unimaginative 10,000-ton design, which was universally adopted after the Washington conference. The displacement has been reduced to 8,400 tons, the main armament from eight 8-inch guns to six, and the cost from £2,000,000 to about £1,600,000. Machinery of 80,000 s.hp. is installed, but owing to her reduced length the speed of the ship, notwithstanding her smaller displacement, does not exceed that of the 10,000-ton cruisers. In the original design of the *York,* three funnels were provided. Subsequently, however, it was found possible to eliminate the foremost of these by trunking the forward boiler uptakes into the second funnel. The appearance of the ship is



THE U. S. 10,000-TON CRUISER *HOUSTON*

somewhat marred by the unequal size of the two funnels. Apart from this, the design is an admirable one in all respects, and but for treaty restrictions, we should probably have built many more "B" class cruisers, which for service with the fleet or for trade protection duties could hardly be bettered. It was proposed to equip the *York* with two aircraft—a seaplane mounted on a catapult on the crown of the second turret, and an aëroplane on a second catapult placed amidships; but as the turret proved unequal to the stresses set up by the discharge of the catapult, the seaplane has had to be dispensed with. H.M.S. *Exeter,* second and last of the "B" class, corresponds to the *York* in tonnage and dimensions, except that the beam has been increased from 57 feet to 58 feet. In contrast to *York,* her funnels and masts have no rake, and the height of the bridge has been reduced. With their bunkers filled to capacity—1,900 tons of fuel oil—both ships will have a cruising radius of 10,000 miles at speeds ranging from 11 to 14 knots.

H.M.S. *Codrington,* our first flotilla leader to be built since the war, was completed in June, having been launched by Swan, Hunter, and Wigham Richardson, Ltd., at Wallsend, on August 7, 1929. The leading particulars are as follows:—Length, 332 feet; breadth, 33 feet 9 inches; displacement, 1,520 tons; geared turbines of 39,000 s.hp., Yarrow boilers working at 300-pound pressure; designed speed, 35 knots. According to *Fighting Ships,* the *Codrington* on her trials maintained a mean speed of 38 knots for four hours, reaching 40 knots at times. "At no time was the machinery pressed in any way, in conformance with Admiralty instructions. If maximum power had been worked up, this ship would have achieved record figures." Assuming this account to be correct, the performance of the *Codrington* reflects high credit on her designers and builders. A second flotilla leader, the *Keith,* was launched by Vickers-Armstrongs at Barrow-in-Furness in July; a third, the *Kempenfelt,* is under construction by J. Samuel White and Co., Ltd., at Cowes; and a fourth, the *Dundan,* is shortly to be started at Portsmouth.

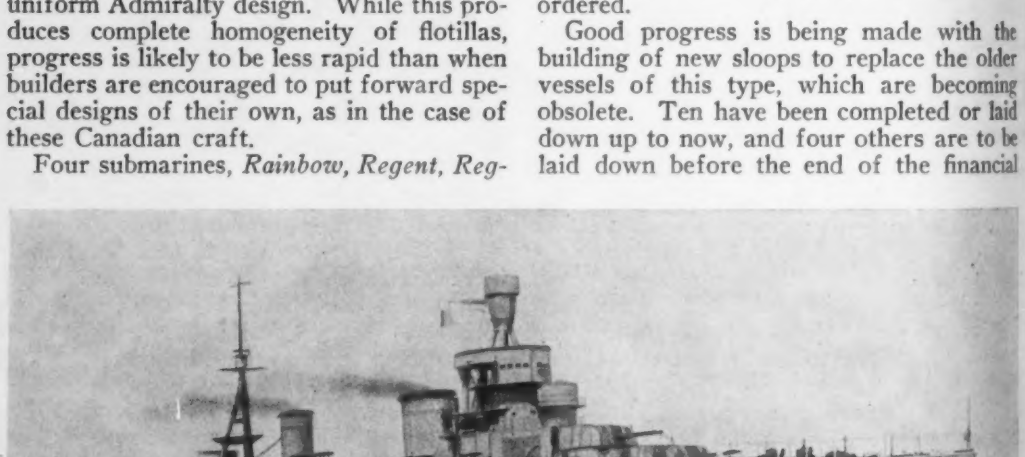
All eight destroyers of the *Acasta* class, built under the 1927 navy estimates, are now in service. They constitute the first group of British destroyers to be completed since the war, following the experimental boats *Amazon* and *Ambuscade,* which were ordered in 1925. The displacement is 1,330 tons, the machinery develops 34,000 s.hp., the speed is 35 knots, and the armament comprises four 4.7-inch guns and eight 21-inch torpedo tubes on two quadruple mounts —the heaviest torpedo armament yet mounted in British destroyers. They are exceptionally handsome vessels, the two funnels of equal height and girth giving them a symmetrical profile in pleasing contrast with that of earlier destroyers. Eight more boats, *Beagle* class, were launched during the year, all from northern yards, and are practically identical with the *Acasta* design.

Of the eight destroyers projected under the estimates for 1929, four were canceled, and of the remaining four, *Crusader* class, two are building at Portsmouth and two by Vickers-Armstrong. Destroyer contracts under the current estimates have been awarded as follows:—*Defender* and *Diamond*, Vickers-Armstrongs; *Daring* and *Decoy*, Thornycrofts; *Dainty* and *Delight*, Fairfield Shipbuilding Company; *Diana* and *Duchess*, Palmer's Shipbuilding Company. In each case the contract includes hull and machinery.

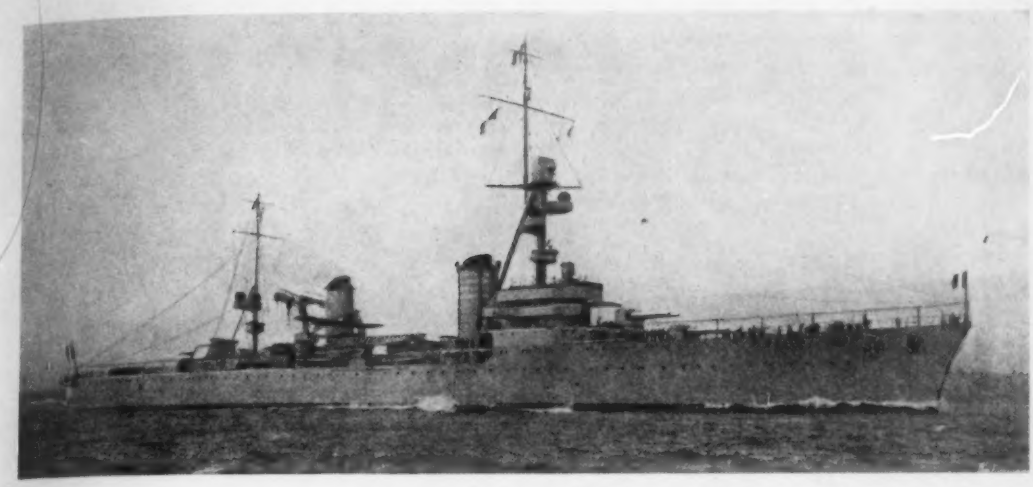
Two destroyers, *Saguenay* and *Skeena*, destined for the Royal Canadian Navy, were launched at Thornycroft's Yard, Woolston, on July 12 and October 10, respectively. In general design and measurements they follow very closely the *Acasta* class, but to suit the requirements of the Canadian service the scantlings have been strengthened and sufficient stability provided to withstand any accumulation of ice on the upper decks, bridges, etc. These destroyers, we gather, embody several "surprise" features, some due to the builders and others to the Canadian technical authorities, and many of them, it is predicted, will be found before long in destroyers of the Royal Navy. Recent British destroyers have all been of a uniform Admiralty design. While this produces complete homogeneity of flotillas, progress is likely to be less rapid than when builders are encouraged to put forward special designs of their own, as in the case of these Canadian craft.

Four submarines, *Rainbow*, *Regent*, *Regulus*, and *Rover*, were launched during the year. Laid down under the estimates for 1928, they are very similar to the six "P" class boats of the 1927 program, having the same surface displacement of 1,475 tons and a speed of 17.5 knots. Like the "O" class, authorized in 1926, they were designed with a view to service overseas. They have good sea-going qualities, and as regards space and ventilation the berthing accommodation is excellent. Including the Australian units *Oxley* and *Otway*, we have now built nineteen of these fairly large post-war submarines. Three more boats have been ordered under the estimates for 1929, but of different types. The first, to be named *Thames*, is a mine-laying submarine of 1,800 tons; the second and third, to be known as *Swordfish* and *Sturgeon*, are comparatively small craft of 650 tons. The latter may possibly be an improved version of the "H" class submarines, which, in spite of displacing only 410 tons, have always been safe, handy, and popular boats. The *Thames* will be the second largest underwater craft built in this country, her displacement being excelled only by that of the *X-1*. Another mine-laying submarine, the *Porpoise*, and two 650-ton boats, *Starfish* and *Seahorse*, belonging to the 1930 program, have been ordered.

Good progress is being made with the building of new sloops to replace the older vessels of this type, which are becoming obsolete. Ten have been completed or laid down up to now, and four others are to be laid down before the end of the financial



THE ITALIAN LIGHT CRUISER *ALBERTO DA GIUSSANO*



THE FRENCH 10,000-TON CRUISER *COLBERT*

year. The displacement is 945 tons, the speed 16 to 16.5 knots, and the armament two 4-inch guns on high-angle mountings. These vessels are, no doubt, of considerable value for miscellaneous service of the foreign stations, where, it has been officially admitted, they are intended to eke out our meager establishment of cruisers. But in tonnage and in other respects they do not compare favorably with the sloops under construction for other navies, particularly the new French *avisos*, which are Diesel-driven ships of 2,000 tons, with a wide radius of action and a battery of three 5.5-inch guns. The *Hindustan*, a slightly larger version of the Royal Navy sloops, was launched by Swan, Hunter, and Wigham Richardson at Wallsend on July 10.

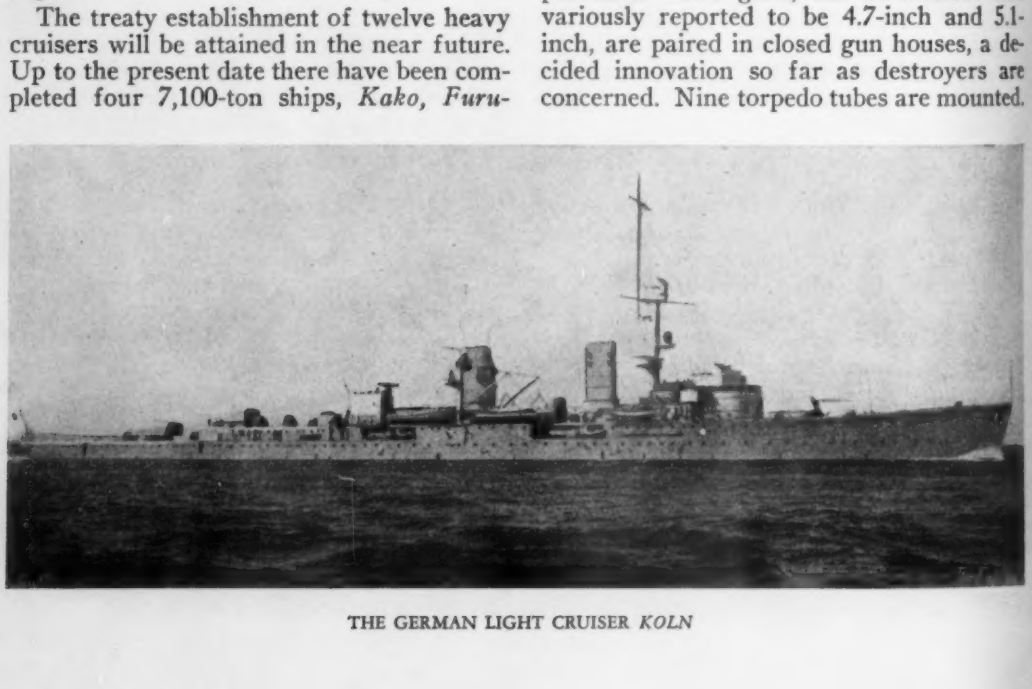
United States

Although the United States is entitled by the London treaty to the possession of eighteen 10,000-ton cruisers, it is not proposed to build up to this establishment in the immediate future. The position to date is as follows: Five ships, *Salt Lake City, Pensacola, Chester, Houston, Northampton,* are in commission; three, *Louisville, Chicago, Augusta,* are completing afloat; five, *Portland, Astoria, Minneapolis, New Orleans, Indianapolis,* are on the stocks; and two others—"CL 37" and "CL 38"—were ordered recently, bringing the total to fifteen ships. The three remaining ships are to be laid down in 1934, 1935, and 1936, respectively, so that the maximum number authorized by the treaty will not be reached before 1939. The *Salt Lake City* and the *Pensacola* are in a class by themselves, their design reflecting the traditional American policy of mounting the heaviest possible armament on a given displacement. They are flush-decked ships, 585.5 feet in length overall, with a beam of 64 feet. The propelling plant consists of Parsons geared turbines taking steam from eight boilers of the White-Forster pattern, working at 300 pounds without superheat, the total weight of the plant being 2,161 tons, and the contract output 107,000 s.hp. for a speed of 32.5 knots. Ten 8-inch 55-caliber guns are mounted in two triple and two twin turrets, the triple turrets being placed in rear of and above the two-gun positions. This arrangement, which is dictated by the layout of the magazines, the ships have very fine extremities, involves the carrying of heavy weights above deck level, and is said to make the vessels very lively at sea. Armor plating is flimsy, and these two cruisers are probably less well protected than our "County" ships. In the later American ships a raised forecastle is provided, the overall length is increased to 600 feet, and the beam to 65 feet, while the armament is reduced to nine 8-inch guns in triple turrets, two forward and one aft. During their two-hour maximum steam trials, *Salt Lake City* average 109,657 s.hp. and 32.77 knots; *Chester,* 109,000 s.hp. and 33.08 knots; *Northampton,* 111,302 s.hp. and 33.17 knots; and *Houston,* 109,849 s.hp. and 33.15 knots.

Two more of the large "V" class submarines, "Nos. 5" and "6," were completed during the year. They are the largest of the class yet built, each being 371 feet in length, with a surface displacement of 2,760 tons. The surface speed is 17 knots. Two 6-inch guns are mounted, and there are six torpedo tubes. These vessels are apparently deemed too heavy or too expensive to be perpetuated, for the *V-7*, laid down in June, is to displace only 1,560 tons, the length has been curtailed to 319 feet and the armament reduced to one 4-inch gun and six tubes. No other construction of importance is in hand, but the new program, which has yet to pass Congress, embraces the following: One 10,000-ton cruiser, fitted with a flight deck and generous accommodation for aircraft, to be armed with 6-inch guns; one 7,500-ton cruiser with 6-inch guns; one aircraft carrier of 13,800 tons; one destroyer leader of 1,850 tons; ten destroyers of 1,500 tons; four submarines of 1,100 tons. The cruisers are acknowledged to be experimental in design and will not be repeated unless their trials prove satisfactory. It deserves to be recorded that the London Naval Treaty, while restricting future British 6-inch gun cruisers to 6,500 tons or thereabouts, leaves the United States free to build 6-inch ships up to 10,000 tons.

Japan

The treaty establishment of twelve heavy cruisers will be attained in the near future. Up to the present date there have been completed four 7,100-ton ships, *Kako, Furutaka, Kinugasa, Aoba,* and four of 10,000 tons, *Nachi, Myoko, Ashigara, Haguro.* Of the remaining 10,000-tonners, *Takao* and *Atago* were launched in May and June respectively, while the *Chokai* and *Maya* will go afloat early this year. The 7,100-ton type has an armament of six 8-inch guns, but the larger vessels carry ten of these weapons, and are thus equal in weight of broadside to the American *Salt Lake City* class. The new cruisers have the characteristic Japanese outline, with an undulating hull line, massive bridges, and trunked funnels. All twelve ships are able to steam at 33 knots. The mine-layer *Itsukushima* of 1,970 tons, launched in May, 1929, has been completed. She is propelled by internal-combustion engines totaling 3,000 b.hp., which give her a speed of 17 knots. The counter, square and overhanging, is pierced with four ports for dropping mines. Three 5.5-inch guns are mounted on the center line. This is the first Japanese warship of considerable tonnage to be fitted with internal-combustion machinery. The twenty-four large destroyers of the *Fubuki* class, several of which are still incomplete, call for some notice. Displacing 1,700 tons, they have turbines of 50,000 s.hp. for a speed of 35 knots. The freeboard is high, the funnels are large, and the upper works lofty, giving the vessels a most formidable appearance. The guns, six in number and variously reported to be 4.7-inch and 5.1-inch, are paired in closed gun houses, a decided innovation so far as destroyers are concerned. Nine torpedo tubes are mounted.



THE GERMAN LIGHT CRUISER *KOLN*

No other torpedo vessels now afloat can compare with the *Fubuki* class for weight of armament in proportion to tonnage. Five submarines of 1,638 tons are under construction, but other details are lacking.

France

Many additions were made to the French Navy in the course of the year, the most notable being the 10,000-ton cruisers *Colbert* and *Foch* and several of the huge flotilla leaders which have become so popular with that service. Before considering these vessels, it will be useful to detail the number and types of units which have been authorized in France from 1922 to the present date, viz.: Seven cruisers of 10,000 tons, armed with 8-inch guns; three cruisers of 8,000 tons, with 6-inch guns; one training cruiser, of 6,600 tons; one mine-laying cruiser, of 4,850 tons; thirty flotilla leaders; twenty-six destroyers; one submersible cruiser, forty fleet submarines, six mine-laying, and twenty-seven coastal submarines; one surface mine layer; one aircraft carrier and one seaplane tender; one submarine depôt ship, five oil-tankers, six colonial gunboats, one river gunboat, one net layer, and one submarine chaser. Within the space of nine years, therefore, provision has been made for 160 new vessels, including 74 submarines. It would be difficult to trace any previous period of history in which French naval power has developed so steadily and progressively as in the years since the great war. Ships of various types, grouped together in homogeneous classes, each group marking an advance in technical efficiency over the previous batch, are ordered, laid down, and completed according to schedule. In spite of the handicap of frequent cabinet changes, there has been admirable continuity in French naval policy throughout the post-war period, and designers and engineers have received every encouragement to exert their native ingenuity. The result is seen in the magnificent fleet which France is already able to muster, a fleet that will be steadily reënforced as the program approaches maturity.

The 10,000-ton cruisers *Colbert* and *Foch*, sisters to the *Suffren*, completed in 1928, which began their trials in the year under review, are somewhat slower than the first vessels of this type, *Duquesne* and *Tourville*, but have superior armor protection. The main armament, eight 8-inch guns, is unchanged, and each ship has three seaplanes, discharged by catapults, in place of the two carried in the earlier units. The *Dupleix*, launched at Brest in October, belongs to the same class. In the *Algérie*, begun early in December, important modifications will be introduced. Protection is to be improved by a slight sacrifice of speed, and one large funnel casing will contain all the boiler uptakes. Moreover, the 8-inch guns are of a new and longer model, and the antiaircraft battery is increased to eight 4-inch pieces. It is proposed to build five further ships named after French colonies, viz., *Madagascar*, *Maroc*, *Tunisie*, *Indo-Chine*, and *Senegal*, to be laid down at the rate of one per year. Their completion will raise the total of French 10,000-ton cruisers to twelve.

The aircraft tender *Commandant Teste*, of 10,000 tons and 20 knots speed, is practically complete. As no flight deck is fitted, the seaplanes will be discharged by catapult and retrieved from the water by derricks, five of which are provided. This ship bears a family resemblance to the *Albatross*, the Australian Navy's new seaplane carrier. The *Jeanne d'Arc*, launched at St. Nazaire last February, is officially classed as a training ship, though she is at the same time a useful cruiser. Length 525 feet; beam 57 feet, 6 inches; draught 17 feet, 9 inches; displacement, 6,600 tons; turbine machinery, 32,500 s.hp., for 26.5 knots; armament, eight 6.1-inch guns in twin turrets, four 3-inch A.A., and two torpedo tubes; the armor protection is scanty. Two seaplanes are included in the equipment. Another special ship completed last year is the cruiser-mine layer *Pluton*, of 4,850 tons and 30 knots speed, armed with four 5.5-inch guns. Work was begun on the first two colonial *avisos*, or sloops, of which it is proposed ultimately to build twelve. They are of respectable size, 334 feet in length and 44.5 feet in beam, displacing 2,000 tons. The machinery consists of two sets of internal-combustion engines, developing 3,200 b.hp., the speed being 15.5 knots. At lower speeds the radius will be 10,000 miles. They carry three 5.5-inch and several small guns, together with a seaplane. Craft such as these are much more suitable for duty overseas than our tiny sloops of the *Sandwich* class.

Twelve large flotilla leaders have now

been completed, and eighteen further ships of this type are under construction. From the *Chacal* class, of 2,362 tons, begun seven years ago, the displacement has gradually risen to 2,570 tons, the speed from 35.5 to 38 knots, and the armament from five 5.1-inch to five 5.5-inch guns. All these craft have exceeded their designed speeds, the *Bison* at present holding the record with 41.2 knots. They constitute a torpedo flotilla which for mobility and fighting power has no counterpart in any other Navy.

Submarine launches were frequent during the year. So far as can be ascertained, twenty boats are now in various stages of construction. Among them is the *Surcouf*, the world's largest submarine, which was launched at Cherbourg in November, 1929. Displacing 2,880 tons on the surface and 4,300 tons when submerged. She is nearly 400 feet long, with a beam of 29 feet 6 inches. A surface speed of 18 knots is expected from the twin Diesels of 7,600 b.hp. The vessel will carry two 8-inch guns, probably in turrets, and fourteen torpedo tubes, with a supply of thirty-six torpedoes. The crew will number 150. The trials of this immense submarine are awaited with interest. She will, it is stated, have a radius of 10,000 miles at moderate speed. Most of the other submarines now building are of standardized type, 1,384 tons on surface, 18 knots speed, armed with one 3.9-inch gun and eleven tubes. Those already completed have proved most successful. They have made long independent cruises without mishap, and the designed speed has in several instances been exceeded. One of the class, *Henri Poincaré*, maintained an average of 17.6 knots in forty-eight hours on her official trials.

Italy

The development of the Italian Navy continues to be rapid and systematic. With the launch of the *Zara* and *Fiume*, both on April 27 last, there are now four 10,000-ton cruisers afloat. The two ships named differ materially from the *Trento* and *Trieste*, completed in 1928, the speed having been reduced from 35 knots to 32, and the armor protection substantially increased. Two similar ships, *Gorizia* and *Pola* were laid down recently, but in another unit, *Bolzano*, also on the stocks, the speed has again been raised, this time to 35.5 knots. Italy, it will be seen, already has seven 10,000-ton cruisers built or building, this being equal to the French total. Widespread interest has been awakened by the completion of the first ships of the *Condottieri* class, a type of light cruiser which appears to have been specially designed for Mediterranean operations and as a "reply" to the big French flotilla leaders. The *Giovanni delle Bande Nere* and her seven sisters are truly remarkable vessels. The first three, built at the Ansaldo yard, have taken little more than two years to complete. Particulars of the class are as follows: Length over all, 554 feet; beam, 51 feet; draught, 14 feet; standard displacement, 4,896 tons (5,009 tons in the last four); machinery, two sets of geared turbines, six oil-burning boilers, s.hp. 96,000 for 37 knots; radius of action at 25 knots, 2,500 miles; armament, eight 6-inch guns in twin turrets, six smaller pieces, four torpedo tubes. The *Alberto da Giussano*, one of the Ansaldo group, running her trials on a displacement of 5,607 tons, is reported to have reached 40.7 knots, and, with her full armament on board, to have maintained 39.8 knots over a course of 160 miles—a truly astonishing performance. Hull and machinery are understood to be of very light construction, and, without any desire to detract from the fine technical achievement they represent, we doubt whether the scantling will long endure the strain of such powerful machinery if the ships are frequently driven at high speeds. Nevertheless, for the time being these eight cruisers have no equal. They are fast enough to overtake the swiftest destroyer, and, with their powerful armament, they could engage any 6-inch gun cruiser without undue risk. The twelve large destroyers of the *Navigatori* class are now completed. Displacing 1,654 tons, they have a speed of 38 knots, and are armed with six 4.7-inch guns and six tubes. Mines are carried by several boats of the group. Twelve later destroyers, of about 1,240 tons each and designed for 38 knots, are being built. It will not have escaped attention that the latest cruisers and destroyers of the Italian Navy are designed for exceptionally high speeds, a policy which appears to be quite sound in view of the peculiar problems of strategy which confront Italy in the maritime sphere. Several large submarines went afloat during the year, and it is proposed to

lay down at an early date no fewer than twenty-two new boats of varying types.

Other Navies

The diminutive German battleship *Ersatz Preussen,* which was begun at Kiel in September, 1928, will be launched in the new year. As is well known, she is of 10,000-tons standard displacement and is driven by internal-combustion engines of 50,000 b.hp. at a maximum speed of 26 knots. The hull is welded, and the machinery and other equipment has been constructed on weight-saving principles. She is to mount six 11-inch guns in triple turrets fore and aft, eight 6-inch guns, four 314-inch A.A. and six torpedo tubes. The design is noteworthy in all respects, and of no other man-of-war now building is the completion awaited with so much interest. Should she turn out a complete success, she may exert a marked influence on the future development of warships, particularly with regard to their propulsion. It is proposed to construct three further ships of this type, to take the place of the obsolete battleships, *Lothringen, Braunschweig,* and *Elsass.* The only German naval unit to be completed during the year was the light cruiser *Köln,* a sister to *Königsberg* and *Karlsruhe,* previously placed in service. The standard displacement is 6,000 tons, the machinery comprises steam turbines for high speeds—up to 32 knots—and an auxiliary internal-combustion plant for cruising purposes. Armament: Nine 5.9-inch in triple turrets, one forward on the center line, two aft *en échélon;* four 3.4-inch A.A., and twelve deck torpedo tubes. The *Leipzig,* fifth and last of the post-war cruiser series, is of the same generic design, but a more powerful internal-combustion plant is installed, the boiler uptakes are housed in a single large funnel, and the 5.9-inch turrets are on the center line.

Apart from some unimportant reconstruction work on old ships, and the laying-down of three submarines at the Baltic yard, Leningrad, there is nothing of interest to report concerning the Russian Navy.

For the Spanish Navy two 10,000-ton cruisers, *Baleares* and *Canarias,* are on the stocks at Ferrol. The completion of these ships, which are to have a speed of 33 knots and a main battery of eight 8-inch guns, promises to be considerably retarded for financial reasons. Four flotilla leaders, 1,650 tons and 36 knots, and several submarines are building at Cartagena.

The Swedish "aircraft-cruiser" *Gotland,* the first ship of her type, was begun during the year. She displaces 5,260 tons, has turbines of 33,000 s.hp. for 27 knots, and mounts six 6-inch guns in turrets. The after part of the ship is reserved for seaplanes and two catapults are carried. In this original type we may discover the salient features of a convoy cruiser which would be eminently suited to British requirements.

The Chilean battleship *Almirante Latorre,* after undergoing an extensive refit at Devonport, including new machinery, is now almost ready for her trials, and is due to leave for South America early in the year. The six *Serrano* class destroyers, built by Thornycroft's, the three large submarines and the submarine depôt ship *Araucano,* all built by Vickers-Armstrongs, have been delivered. Complete satisfaction is expressed by Chilean naval officers with the performances of these craft.

The Argentine government has taken delivery of the twin cruisers *Almirante Brown* and *Veintecinco de Maya,* which were ordered from Italian yards and launched in August, 1929. They are handsome and, for their tonnage, very powerful vessels. Displacing only 6,800 tons, they are able to steam at 32 knots. Six 7.5-inch guns in double turrets, twelve 3.9-inch A.A. guns, and six torpedo tubes, constitute the armament. Three flotilla leaders, *Mendoza, Tucuman* and *La Rioja,* of 1,520 tons and 36 knots, have been completed for the Argentine Navy by J. Samuel White and Co., of Cowes. All bettered their contract speed, *Mendoza* and *Tucuman* maintaining 38 knots for six hours and *La Rioja* reaching 39.4 knots without exceeding the designed horsepower.

ENGINEERING

Non-Destructive Tests of Welds

Mechanical Engineering, February.—In the case of welds, non-destructive testing is particularly important because the quality of a weld is affected by a number of factors which may not have been active in the case of any other weld. Destructive testing may therefore be used for purposes of general investigation, but indicates little as to the quality of any other weld but the one tested to destruction. Of late magnetic

methods of testing have been developed, however, which may be applied to the investigation of individual joints without destroying them. These methods are applicable to butt welds, i.e., welds in which the edges are jointed together without lapping. The apparatus is portable and is said to require very little skill and training on the part of the tester.

The tests are made by "bridging" the welded seam with a large horseshoe electromagnet and "exploring" the magnetic field in the vicinity of the weld with a meter.

NON-DESTRUCTIVE METHOD OF TESTING OF WELDS BY BRIDGING

This is really a further development of the method devised by M. Roux, a French investigator, to "explore" the weld by placing iron filings on a piece of paper over the weld and observing the density of the filings as they are affected by the density of metal in the weld. This method, however, is good only when the surface is smooth and the faults are not too far below the surface.

By passing the meter over the weld and watching the pointer, the quality of the weld can readily be determined. The meter indicates the "reluctance" of the weld by "reading" the magnetizing forces across the weld as compared with the magnetizing forces of the steel plate. If the magnetizing forces are about the same, the weld is good; if not, the weld is bad and the meter will tell just how bad it is.

This method is practically indifferent to the depth of the fault below the surface and is only slightly affected by a rough, uneven surface. Various new types of weld test-meters are now being developed.

After several months' investigation of both the "iron-filing" and weld test-meter methods by the research laboratories, they are expected to be used in the near future at the East Pittsburgh works of the Westinghouse Electric and Manufacturing Company on large butt welds in structures such as generator-frame rings, flywheel rims, and welded pipe. (T. P. Watts, of the Research Laboratories, Westinghouse Electric and Manufacturing Company, before the American Welding Society, September 24, 1930, Chicago, Illinois.)

RADIO

Aëronautic Radio Developments

Journal of the Franklin Institute, January.—Progress can be reported in the development of a combined transmitter for the simultaneous broadcast of radio, telephone, and visual type radio range beacon signals. This is designed to remove the principal limitation on the present radio aids to air navigation, viz., that the pilot receives no beacon service while receiving weather or other telephonic information. A master oscillator controls simultaneously a radio telephone transmitter and a beacon transmitter. The former supplies the carrier-frequency waves and the speech-modulated waves of an open antenna. The latter supplies only the radio beacon sidebands to the beacon loop antennas. Filter arrangements and automatic volume control have been worked out to facilitate the reception of these signals aboard the aircraft. The fundamental adjustments necessary in the experimental model of this transmitter have been completed, and performance tests begun at various distances from the station. A number of tests were made approximately 125 miles from the transmitting station; in these tests successful reception of both the voice and beacon signals was accomplished, with indications that this reception could be obtained over greater distances. Satisfactory sharpness of beacon courses was obtained. As a result of these and other tests the feasibility of the combined service is assured.

For some months a detailed study has been in progress on the characteristics and performance of airplane receiving antennas

of various types. One object of this investigation was to find an antenna arrangement having the same desirable electrical characteristics as the vertical pole antenna but free from the problems of mechanical vibration and ice formation encountered in the use of the pole antenna. One of the advantages of the vertical pole antenna is its freedom from course errors in radio range beacon reception. A number of different antenna arrangements have been studied, both by theoretical analysis and by practical observation in the air and on the ground. For each antenna studied, the tests in the air included observation of the received voltage, the localizing effect or variation of the received voltage in the immediate vicinity of the beacon tower, and the course errors as observed by circling the beacon. These were compared directly with results obtained using the vertical pole antenna. The antenna arrangements studied included the inclined antenna, with both forward or backward inclination (one example of the latter being the trailing wire antenna); the horizontal dipole antenna; the horizontal V antenna; the horizontal L antenna; the inclined V antenna; the symmetrical transverse T antenna; and the symmetrical longitudinal T antenna. The symmetrical longitudinal antenna with a vertical lead-in was found to have an advantageous combination of the desired operating characteristics. The two flat top elements lie along a line parallel to and directly above the axis of the fuselage, held by short vertical supports, considerably shorter than the usual pole antenna (ten to eighteen inches instead of five to six feet). Equivalent effective height is secured through the use of the flat top. It is essential that the longitudinal T-antenna be located in a position such that the electrical effect of the airplane frame acting as the counterpoise is symmetrical; this is not always possible in the case of open cockpit airplanes, but is usually possible in cabin airplanes. This type of antenna is free from course errors in radio range beacon reception. It is superior to the vertical pole antenna structurally and in respect to ice formation, mechanical vibration, and aërodynamic resistance.

The bureau has begun preliminary work on the development of a radio system to aid in preventing collisions between airplanes. The aim is to give automatic warning to an airplane of the presence and approximate position of any other airplane within a radius of about three miles. A fundamental limitation is that only one frequency, or at most a very few frequencies, can be made available for this service. The system involves the continuous transmission of ultra-high-frequency radio waves from each airplane. Directivity of reception or transmission, or both, will inform the pilot of the direction of danger.

AVIATION

New Five-Year Air Program

New York *Herald Tribune*, January 18.—In the light of preparations now being made it is becoming apparent to observers of this country's military aircraft operations that the ending, last week, of the ten-year controversy over the dividing line of work between the Army and Navy forces, which led to the granting of the air coast defense domain to the Army, was not in any sense a restriction of Navy air activities.

The Navy will strengthen its air forces and consolidate them for the first time with the fleet, and incidentally use the accord as a basis for a new five-year aircraft building program for the sea service.

Under the agreement the naval air force will be based on the fleet and move with it, while the Army air force will be land based and used in defending the coasts, both at home and in overseas possessions, thereby assuring the fleet absolute freedom of action without responsibility for coast defense.

The declaration of this policy by the Navy, following the long drawn-out dispute over the coast defense, which finally was carried to President Hoover last August, was interpreted in some Army circles as representing a recession on the part of the Navy. On the contrary, it now appears that this latest move merely strengthens the policy which Navy leaders have been seeking to establish, that the air forces are merely an adjunct to the land and sea forces of the nation's military services, and that it is immaterial whether they are based on land or on the sea.

By confining the Navy's aërial strength to the fleet, it is now pointed out, the Navy General Board is able to strengthen its contention that there is little difference between a gun and a plane, one being merely a fixed weapon, the other a flying weapon.

It is on this theory that Navy leaders intend to advance in developing the Navy's strength and thereby capitalize on the victory won at the recent London naval conference, at which it was agreed that 25 per cent of the nation's cruiser strength could be converted to airplane carriers.

The crux of the Army-Navy controversy had involved two air bases, one at Coco Solo in the Panama Canal Zone, and the other at Pearl Harbor in Honolulu. But there were only twenty-four planes of the Navy based at Panama and thirty-two at Pearl Harbor.

The drawing of this slight aërial force into the fleet, which is to be accomplished under the terms of the accord agreed upon between high ranking officials of the Army and Navy, will fill only a small portion of the necessary Navy plane quota if the naval air forces are to be considered in the same light as stationary guns, and if full advantage is to be taken of the cruiser-airplane strength permitted under the terms of the London treaty.

No exact official estimate has been made of the number of planes which can be housed afloat under the treaty conditions, but it is understood that the force is sufficient to take care of a new five-year aircraft building program. It is thought likely that for this reason the Navy leaders will not announce a new five-year program, but will be content to ask for what will appear merely as necessary equipment in the form of "flying guns" to build up the allotted air strength of the Navy.

Lessons of Italian Transatlantic Flight

New York *Times,* January 18.—By General Italo Balbo. With the last stage of our flight, Bahia to Rio de Janeiro, the Italian squadron has finished its planned flight of 10,400 kilometers (6,450 miles) over three continents and the Mediterranean and Atlantic seas. If the Italian enterprise had aimed at the establishment of a record or a great sporting event, I would have nothing to add.

The flight was made in perfect formation; the Atlantic was conquered this time not by a single plane, but by a group of wings which flew over the ocean without interruption of the formation by any of the units of the flying squadron.

There is something in this Italian feat that should be considered as beneficial to aviation throughout the world. For this reason I believe it opportune to publish a detailed account of the experiences of our squadron.

Although a plane was lost at Bolama, Portuguese Guinea, and another was rendered useless, the twelve other machines would have attained the goal had not a stupid accident impeded the twelfth when it was in plain sight of Natal Harbor.

[The plane capsized and was sunk as it was being towed to Natal from off the Island of Fernando do Noronha, where it had been forced down.]

The percentage of losses was far under the calculations I made prior to the departure.

Our machines showed extraordinary powers of resistance and stability, especially during a storm which we met in our flight, giving proof they were true air-naval units, capable of crossing seas just like any ship with proper means of navigation.

I have nothing extraordinary to note about the flight in the early stages between Cartagena, Spain; Kenitra, Morocco; Villa Cisneros, Rio de Oro, and Bolama; stages of six, seven, and eight hours of regular navigation. I may say that in Kenitra we had strong seas and that the planes were heavily laden. I remember sand clouds abounded in the neighborhood of Cabo Juby, a new element for us. This was the first skirmish in the tropical flight over Africa. Our planes flew over those clouds without difficulty.

But the dramatic, tragic point was still to arrive. It was, as we had foreseen, the take-off at night in Bolama.

We faced the trial under especially difficult conditions. And because of this we feel certain that our experience was definitive in its lessons, since we took off in groups of three on a dark, moonless night, over waters whose surface we could not see; over a maritime mirror whose horizon was invisible. It was indeed a completely blind take-off, depending entirely upon the efficiency of the planes and their crews.

The crews in our case responded to our most optimistic hopes and no charge could be made against the crews of the planes which met accident. In those cases the imponderable factor which overcomes human courage and will power should be considered.

But the tragedy lay exactly in this; that I could not remain waiting for more favorable

weather without risking the loss of the few last days of full moon and thus being forced to delay the flight for more than a month.

As soon as the planes were lifted by their own impulse, we fixed the altimeters at zero and trusted to the precision of our apparatus. There was nothing else we could do but "give them the gun" and fly onward. It was impossible to try to steer by landmarks. Darkness was everywhere. We might, for all we knew, be at two meters or at 200 meters over the sea. With the altimeter we regulated our flight.

Darkness prevailed during the first six hours of our flight through clouds whose cumuli covered the entire horizon. It was useless, even dangerous, to attempt to look outside the cabins in a vain effort to tear the curtain of darkness and see at least the sea level. The lamp hanging from the wings served to indicate the position of the other machines, and indicated that the formation was orderly.

Before taking off we had dumped all the excess baggage, even the rubber boots. I had ordered my companions: "Arrive with the plane or don't arrive!"

The transoceanic flight would have presented no interesting features if the planes had not been forced to maintain their perfect formation at all times. That was our worry from the beginning. To fly in formation for eighteen consecutive hours means that the motors must not only rotate perfectly synchronized but that they must be equally efficient.

I am frank to say that if I were to fly the ocean again I would rather do it three times alone than only once in strict formation.

We were not pestered by rain. Rain always alarms the neophite on the ocean. And so do the first hours, which seem unusually long. But by and by one gets used to it and begins to realize that an hour at sea has sixty minutes too. Once that is understood, the problem is to conquer the hours that are to come.

The route was kept without error, thanks to the precision of the compasses. Before departing I had said that the planes would fly identically as a steamship sails. I had some doubts about the relative speed of the machines in view of the contradictory information on the weather. In spite of this our speed was rather high on the average surpassing predictions.

I also noticed that the planes gained speed with the hermetic closing of the cabin windows.

During the flight we proved the excellence of the new radio models, which permitted us to keep in constant touch with ships and with Italy. These weigh seventy-three pounds and were constructed to the design of the Department of Experimental Aëronautics.

The conclusions are evident. I studied the motors carefully and I may say that they are highly efficient. The South American stages proved that it is possible to establish aërial traffic over the Brazilian coasts. From Natal to Bahia the coast offers numerous good harbors. It may be said that there are good and safe landing spots at periodical distances of twenty kilometers.

Our feat can be repeated by others, and even improved upon. It can be improved by ourselves over other routes such as the North Atlantic to the United States.

The progress of aviation is connected with that of the military and civil power of peoples. It constitutes its own propeller in rhythm with contemporaneous civilization. Italy has faith in aviation. Italy's chief has given to Italian youth not only wings, but heart, and he beckons us to go onward.

Aviation Charts of the Upper Air

New York *Times,* January 25.—A prediction that the time will come when charts of currents in the upper air will be as common and as valuable to aviators as charts of air currents on the ocean's surface have been to surface sailors, was made recently by Rear Admiral Walter R. Gherardi, hydrographer of the Navy, in a radio address. Already some progress is being made along these lines. Each month the Hydrographic Office issues pilot charts of the upper air for the North Atlantic and North Pacific.

"In our studies of the upper air," Admiral Gherardi said, "it seems reasonable to predict that the aviator will eventually have charts that will point out to him air currents of the upper air as did Maury's pilot charts show the winds on the ocean's surface to the navigators of sailing vessels. . . . As was the case with nautical charts, when air commerce creates the demand, . . . these upper air charts will become of such importance to the aviator in long flights that they will be issued to cover all parts of the globe."

At the present time, currents in the upper air are not considered of very great importance to aviators who are chiefly concerned with the lower atmosphere. The atmosphere is sharply divided into two regions, differing markedly in their characteristics: a lower region, known as the troposphere, and an upper region, or stratosphere. The entire earth is first enveloped by this lower region, which varies in height from about 26,000 feet in the polar regions to about 56,000 feet in the tropics. Above the lower region is the stratosphere, or upper air. It is for the upper air that the Hydrographic Office is now issuing monthly charts. Conditions in the lower region are, of course, recorded and predicted for the use of aviators by the Weather Bureau.

These two regions differ from each other principally in the following respects: First, in the lower region clouds are common, while in the upper region there are no clouds. Second, the temperature of the lower region decreases as its altitude increases—that is, the higher an aviator rises the colder the atmosphere becomes. If, however, he were to rise into the upper air, he would find little further vertical change in temperature.

In making his prediction that charts of the upper air would some day be in general use, Rear Admiral Gherardi was no doubt looking forward to the day when aviators would find it practicable to make long flights through the upper air. If the projected rocket planes are ever successful, they will probably follow routes through that region. Meanwhile, it is believed that upper air currents affect conditions in the lower region, and their study, therefore, is helpful.

The Autogyro

U. S. Air Services, January.—The most extraordinary figure that has loomed on the aëronautical horizon since the days of the Wright brothers is Señor de la Cierva, inventor of the autogyro. This fact must be admitted regardless of any predilections for or aversion toward the autogyro itself. The name of its inventor is destined to go down in history, if not *with* the Wrights, that would be too much to expect of any name, at any rate as the name of the first man to hit upon a radical innovation in the Wrights' system of securing controlled free flight.

That statement may seem extravagant but it will stand examination. Heavier-than-air flying, with the single exception of the autogyro, is today in method exactly what it was as demonstrated by the Wrights a quarter of a century ago. Their work has been developed, refinements have been introduced, power plants have been perfected; but the fundamentals are the same. It remained for Cierva to try something distinctly different, something different, that is to say, *that works.*

It is curious though not perhaps surprising that this fact has been overlooked by many. It was overlooked by a recent contributor to a popular magazine of nation-wide circulation. In an indictment of modern aviation he asserted that flying today is substantially what it was during the war, and no different at all in principle than it was in the days when the Wrights got their strangle hold on it over the dunes of Kitty Hawk. While this is a refreshingly honest admission of what flying owes to its real discoverers, it overlooks completely the novel and comparatively recent departures of Cierva. Of course the writer mentioned may, with a good many others, disparage Cierva's invention as a device of practical utility, but from the standpoint of sheer originality and workability combined it is certainly entitled to notice. Even if we recognize that it introduces no new principle, we must admit ungrudgingly that its application of the established principle is altogether new and decidedly ingenious. It marks the first revolutionary departure in design since the days of the first heavier-than-air machine, and incidentally the first radical departure in certain details of control.

Note the outstanding differences. In an airplane, roughly speaking, it is wing area which determines its landing qualities. In the autogyro, it is not wing area but *disc area.*

In an airplane rigidity of lifting surfaces is essential. In the autogyro it is not so. On the contrary flexibility is essential. Incidentally this flexibility may, by preventing sudden overloads, account for another paradox—it makes, to quote the inventor, "the autogyro the stronger the flimsier it looks."

In an airplane the landing speed increases generally as the top speed. The autogyro can, within wide limits, be designed to have very different top speeds but exactly the same desirable features of slow landing and descent.

In an airplane you push on the stick to ensure or regain control. In an autogyro you pull back. You are perfectly safe in a stall, and about the only thing you mustn't do is put it in a dive.

The wind tunnel which has proved so useful in the analysis of airplane performance ever since its epochal utilization by the Wrights gives but little help in defining the performance of the autogyro. Indeed the discrepancy between model tests and full-scale results has been bewildering.

The comparison might go further, but the items mentioned are enough to show the originality of Cierva's idea. He is to be congratulated on more than sheer originality, however. He is to be honored preëminently because he did what he set out to do. In that respect he most nearly resembles the Wrights. The Wrights set out almost without precedent in the deliberate attempt to achieve controlled free flight—and they achieved it. Cierva set out to secure a "slow-landing machine," and he secured it—and that, too, along unprecedented lines.

And so while their devices are radically different, the men who designed them have certain conspicuous points in common, and one of the latter which must not be overlooked is this: they all survived their own experiments and lived sound of wind and limb to see the culmination of their hopes. Like the Wrights, Cierva demonstrated that what is right in theory has to be right in practice, and he, like them, has proved his theory correct. He did not leave the demonstration to others. He did the job himself and without a single accident of importance in the process. He had a supremely important tale to tell, and he has lived to tell it. Is he not well worthy of the world's sincere salute?

Forthcoming Tests of Compression Ignition Engines

New York *Herald Tribune*, January 4.—The supremacy of Germany in the airship motor field will be challenged in the next few months, it was learned at the Navy Department this week, when tests of two American-made compression ignition motors, the products of years of intensive research, are carried on with the hope that these power plants will prove suitable for installation in the second of the Navy's two superdirigibles, the *ZRS-5*.

That two airship Diesel engines, of comparatively large horsepower, are scheduled for delivery before June 30, 1931, the end of the current fiscal year, was disclosed in the annual report of Rear Admiral William A. Moffett, chief of the Bureau of Aëronautics.

Details of these engines are being guarded closely by engineers and lighter-than-air experts of the Navy, yet it was learned authoritatively that preliminary trials of one of the engines are under way, while construction of the second is nearing completion.

Navy officers generally are reluctant to discuss their hopes in these engines, but Admiral Moffett is frank to admit he is optimistic that the second of the two big rigid ships will be powered with American motors. Other officers were more conservative, pointing out that the exhaustive tests which must be made may last until after work on the *ZRS-5* has started.

The two forthcoming engines, representing the most promising results of the five-year research carried on by the Navy and National Advisory Committee for Aëronautics, are expected to be considerably lighter than the recently developed British "Beardmores." The British motors were installed for the first time in the wrecked *R-101*. Principal objection to them has been that they were excessively heavy, but Navy men here are careful not to criticize them in too specific terms.

Except for admitting that they believe the weight-per-horsepower problem has been solved, Navy officers decline to comment on the total weight of the experimental motors. One of the engines is expected to produce nearly 1,000 horsepower, and it is said that preliminary trials indicate the ambitions of the builders will be realized. The second, which is still to receive its first actual test, is rated at between 700 and 800 horsepower on paper. In contrast to the Packard Diesels, these two new motors will be water-cooled and consequently not of the radial type. The anticipated fuel consumption is another topic, however, which is not discussed.

Admitting the satisfactory performances and superiority of the German Maybachs, the gasoline-burning motors which propel the *Los Angeles* and have been purchased for installation in the *ZRS-4*, Admiral Moffett states that the two domestic experimental motors look "very promising."

"The bureau looks to the compression ignition heavy oil engine," the admiral remarked in his report, "as the airship engine of the future, and has been concentrating its effort and experimental funds on its development. Two such experiment engines are now under contract and both are scheduled for delivery within the present fiscal year."

The exact nature of the trials of these engines has not been decided at the Navy, but it appears certain they will be run for many hours on test stands. Whether they will be given flight tests in either the *Los Angeles* or the *ZRS-4* is as yet uncertain. Many months must be spent in examination, trials and checking, however, one officer asserted.

Hydrogen and Helium Mixture for Airship Inflation

New York *Herald Tribune*, January 11.—Consideration is being given to the possibility of increasing the lifting power of the Navy's new airships by more than 4,000 pounds through the use of a mixture of helium and hydrogen instead of pure helium, it was learned today at the Navy Department.

While some difference of opinion exists in regard to the safety of certain repurification problems, it is believed that any problems which would arise are "not insurmountable" and that no reason can be found which would make such action impracticable.

A mixture of 90 per cent helium and 10 per cent hydrogen suggested by German scientists would add 4,600 pounds to the gross lift of an airship of the size of the *ZRS-4*, chemical engineers estimate. Inflated with such a combination of the two gases, the 6,500,000-cubic-foot ships would be able to carry about twenty-five more persons or about 450 more gallons of gasoline.

Combination of the gases in these proportions would not affect the safety factor, one of the distinctive characteristics of American dirigibles, for industrial chemists have determined that the mixture is not inflammable up to this point. Although combustible when hydrogen is present in a greater proportion, the resultant combination would not become explosive until the hydrogen concentration reached 15 per cent.

Hydrogen would escape through the gas cells faster than would helium, while air would diffuse into the envelope and tend to reduce the potential danger. Apparently there is no reason why the combustibility of the mixture would not decrease rather than increase.

Repurification would present the principal problem, but work is now under way to determine the practicability of using a catalytic agent, probably copper oxide, to remove the hydrogen and oxygen in the form of water. The excess of either gas, as well as small amounts of nitrogen which would enter as a component of air, would then be removed through liquefaction.

If this research is successful, as Navy men expect it to be, it then will be necessary to add only a comparatively simple unit to existing repurification plants for cleansing the gas and restoring the maximum lifting power to the hydrogen-helium mixture.

Development of Military Airplanes

Aviation, January.—By Major Clinton W. Howard. In last year's experimental procurement program of the Air Corps the foremost emphasis has been placed upon increased speed for all military types of airplanes. The corollaries of this major trend are, in order of importance, increased power, clean design, and decreased weight, multiplicity of types.

The principal advances in airplane performance are the result of engines of greater power and efficiency. The present policy of the materiel division, therefore, in order to meet the constant demand for improved performance by the tactical organizations, is to devote its major effects to the development of power plants.

Increased speed can best be obtained by increase in power for a given piston displacement, and the trend of experiment for both liquid and air-cooled engines has been in that direction. The power of the present standard air-cooled and liquid-cooled engines has increased from 10 to 20 per cent during the past year, as a result of fundamental studies involving compression ratio, supercharging, revolutions per minute, and increased brake mean-effective pressure. The limits of these improvements are not in sight. There are at present outstanding definite requirements and specifications for an engine of 1,000 hp., having the same displacement as the existing 600-hp. types.

Increased power as represented by the engines developed along these lines can only be

obtained by the use of fuel which is an improvement over the present domestic aviation gasolines. The United States possesses ample resources of high-grade crude oils suitable for the production of gasoline with exceptionally high antiknock ratings. The petroleum industry, in coöperation with the Air Corps, has produced and made available to the American aviation industry a fuel conforming to the extremely rigid requirements of the new Army aviation gasoline specification. The trend is toward a continuation of researches in fuel development, which it is believed offers possibilities for much further improvement in engine performance.

The advanced models of airplanes of strictly military types utilize liquid-cooled engines with their decreased resistance, improved susceptibility to efficient cowling, and Ethylene-Glycol as a coolant. From a structural standpoint these airplanes show a definite trend toward all-metal construction. The metal monocoque fuselage has distinct advantages over the now standard type of structure for the Army (fabric-covered steel fuselages with composite fabric-covered wings). There is a saving in weight and a decided improvement in stream-lining and consequent reduction in drag.

New models include both biplanes and monoplanes; however, there is a strong trend toward the monoplane. The "gull wing," has been found to have some advantages from the standpoint of vision, and the disadvantages from an aërodynamic standpoint are in some instances less than anticipated. In other instances these disadvantages are sufficient to make questionable the usefulness of this type of wing structure. Some years ago it became apparent that along with the increase in power of engines other means should be sought to improve the performance of military airplanes. The internally braced all-metal monoplane wing offered the logical means of reducing parasite resistance. A vast amount of work has been devoted to the structural and aërodynamic aspects of this problem by the materiel division and by the manufacturers of commercial and military aircraft, with the result that the objections to the monoplane for military airplanes that are dived to their terminal velocities have been overcome. Wing "flutter" has been eliminated and the desired strength obtained by the use of suitable materials and methods of construction. An internally braced metal-shell type wing of duralumin construction throughout has been recently tested. It has a span of 55 feet and with a unit weight of 1.83 pounds per square foot, it carried without failure a maximum load of 120 pounds per square foot. Such a wing is suitable for an airplane of 5,000 pounds gross weight, designed for a load factor of ten under high incidence conditions. There are now being produced all-metal monoplanes (monocoque fuselages) for attack, bombardment, pursuit, and observation airplanes.

Increase in speed at altitude has been obtained by supercharging, with the Turbo exhaust-driven supercharger appearing most promising. However, all superchargers increase the weight of the engine and fuel load, with the result that the weight of a 600 hp. engine installation, plus the fuel load, is more than 50 per cent of the gross load for present experimental single-seater pursuit models. This indicates that there will be, for engineering reasons, a trend toward a biplace fighter for high altitude, as the increase in the structure necessary for an additional cockpit is very slight and practically the same performance has been obtained with the two-seater as with single-seaters with the same engine.

Expressed in another manner, the difference in performance between a single and two-place airplane built around a 300 or 400 hp. engine is much greater than the difference in performance between the most efficient single and two-place airplanes built around a 600 hp. engine. With greater increments of power the advantage will be still more in favor of the two-place airplane and there will be a tendency toward the elimination of the single-seater fighter for use at high altitudes.

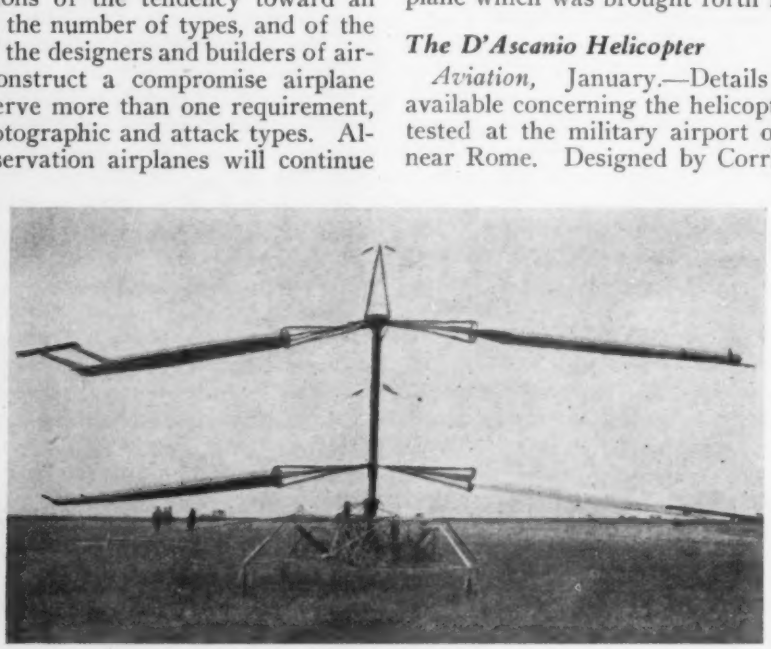
The trend of all military airplane design is toward an increase in the number of types and models of a type. As now established, there are eight major types of aircraft specified for the use of the U. S. Army Air Corps. These are designated as attack, bombardment, observation, pursuit, transport, photographic, primary training, and basic training. The experience of the past year with both experimental and standard service type airplanes has shown that in practically all instances the performance of the existing planes is not sufficiently flexible to meet their function satisfactorily when a

given model has been required to do the work of more than one classified type. The sacrifices in performance, especially speed, have been too great for the advantage gained from the maintenance and supply standpoint by reducing the number of types. Although there has been some increase in the scope of the tactical requirements to be met and in the variety of functions that the military airplane must perform, the increase of the number of distinct types as listed above has been due largely to engineering developments. It is also to be noted that the absence of a perfected and standardized variable pitch propeller has resulted in an abnormally great loss of horsepower and efficiency at altitudes less than the highest at which the rated horsepower of the engines can be developed. That is, the airplane with a supercharged power plant has a great advantage in performance at high altitude over the airplane with the same engine not supercharged, but is decidedly inferior near the ground. A variable pitch propeller will not completely solve this problem, however, and there is, and still will be, a necessity for two or more models of some military types in order to insure maximum performance under all conditions and at all altitudes.

Illustrations of the tendency toward an increase in the number of types, and of the inability of the designers and builders of aircraft to construct a compromise airplane that will serve more than one requirement, are the photographic and attack types. Although observation airplanes will continue to carry photographic equipment in war, there is a definite need for a special airplane which has little or no application to other military purposes except that it can readily be converted into a light transport. The characteristics of the present standard attack type airplane, which is a modified observation airplane, differ widely from the experimental models now under construction. The new models are low-wing monoplanes with monocoque fuselages, racing type wings, and in some instances equipped with slots and flaps. They are powered with either direct-drive or geared Curtiss Conqueror engines using Ethylene-Glycol as a coolant. The increase in speed is in the range of 50 m.p.h. over the present standard attack airplane, which is obtained by the sacrifice of characteristics essential for observation airplanes. The novel features of this airplane are the engine installation and the landing gear design. The landing gear, electrically operated, folds back into the engine nacelles, the wheels completing the streamline section of the engine cowls. The difference of speed with the wheels up and down amounts to approximately 15 m.p.h., which is well worth the additional weight on this particular type. This type of landing gear traces its ancestry to an Army racing plane which was brought forth in 1923.

The D'Ascanio Helicopter

Aviation, January.—Details are now available concerning the helicopter, recently tested at the military airport of Ciampino near Rome. Designed by Corridino D'As-



THE D'ASCANIO HELICOPTER

canio and financially backed by Baron Pierro Trojani, it incorporates many excellent design features. Even more important, it has achieved a series of successful flight tests unprecedented in helicopter development.

The lifting surfaces consist of two 2-bladed rotors, very similar in form to those of an autogyro, being of about the same plan form, section, and general magnitude, and having the same feature of being free to rotate in a vertical plane, relying on centrifugal force to maintain an approximately horizontal position. The two rotors turn in opposite directions, the upper making about 75 r.p.m. and the lower about the same speed. Since they are connected through a differential device, their torques are balanced out regardless of their separate speeds or angular settings. Each blade is fitted with a small, trailing stabilizer, controllable from the cockpit, and can itself be rotated about its longitudinal axis through the same set of controls. These rotors are driven by a 90 hp. Fiat air-cooled engine, though in case of engine failure they continue to rotate as an autogyro. The fuselage is of nickel steel tinned tubing, and is mounted on three wheels of the castor type. Landing loads are absorbed through ordinary rubber shock cord.

The systems for stability and control are especially ingenious. On separate outriggers are mounted three adjustable pitch propellers, two in the horizontal plane and one in the vertical. Driven from the rotor shaft, these propellers are available for control even when the engine power is cut off and the large blades are operating as an autogyro. The controls are surprisingly simple. They consist of an ordinary control-stick and rudder bar, and one additional lever operating fore and aft. These are so connected that a forward or backward motion of the stick varies the pitch of the propeller furnishing longitudinal control so as to depress or raise the nose; a motion to the left or right, the pitch of the propeller for lateral control; and a movement of the rudder-bar that of the propeller mounted in a vertical plane and controling direction. The fore and aft lever controls the stabilizer setting and angle of incidence for all the blades together. Pulling it back results in an ascent, and pushing it forward in a descent.

The machine has already completed the following flights subsequent to its initial tests inside an airship hangar:

A vertical climb from a 50-foot circle to a height of 20 feet remaining motionless over a fixed point for one minute and thirty-one seconds.

A climb from the same circle and a flight in a closed circuit not less than 3,000 feet in length and return to point of take-off.

An ascent to an altitude of 59 feet.

A flight along a straight line of 1,836 feet, terminated only by the boundary of the field.

A duration flight of eight minutes and forty-five seconds.

Flying Conditions at Gibraltar

Army, Navy, and Air Force Gazette, January 15.—Experimental work in a wind tunnel has been done on a model of the Rock of Gibraltar, scale 1/5000, to determine the wind disturbance in lee of the rock; and this has been followed by work at Gibraltar itself with balloons, theodolities, and kites. Examination of the results of the investigation is not yet completed, but provisionally the following deductions have been made. At Gibraltar, winds are turbulent for two miles at least in lee of the rock in an easterly wind, and from sea level up to 5,000 feet or more. Areas of strong turbulence extend to a mile outside the harbor and a mile from north to south, and the disturbed area shifts its position with any change of the free wind direction of the day. Destructive vortices and eddies exist in the mid-region, and some sweep from the 3,000 foot level, at least, down to the sea, within a horizontal travel of three-fourths of a mile. Vertical components of wind velocities at Gibraltar, as measured by balloons, reach 600 feet to 800 feet per minute, and this probably means that they attain 1,500 feet per minute or more, up or down, over short intervals of time such as one-fourth minute. Up currents are perhaps a little stronger than down currents, and are considerably more frequent. An Admiralty diagram shows the areas of greatest flying risks for seven wind directions from northeast to southeast.

NOTES ON INTERNATIONAL AFFAIRS

FROM JANUARY 2 TO FEBRUARY 3

PREPARED BY PROFESSOR ALLAN WESTCOTT, U. S. NAVAL ACADEMY

UNITED STATES AND LATIN AMERICA

REVOLUTION IN PANAMA.—As another instance of the spreading epidemic of revolutionary disturbances in Central and South American states, the little republic of Panama on the night of January 1-2 underwent a brief but successful revolt which overthrew President F. H. Arosomena and placed Dr. Ricardo J. Alfaro, Panamanian minister at Washington, in office as his successor. Dr. Alfaro was named as first designate (or successor in the event of the president's office being vacated) in the election of 1928, and his succession was in accord with a Supreme Court decision which declared the later election fraudulent and the designates named at that time ineligible.

The revolutionary forces seized numerous party leaders and then gained access to the presidential palace after some fighting in which ten were killed and twenty-four wounded, including an American press man. After consultation with the American minister, Roy T. Davis, President Arosomena decided to accept the situation, and turned over the government to his prime minister, Harmodio Arias, who was also leader of the revolutionary movement. Senor Arias remained provisional president until Dr. Alfaro returned to Panama and took office on January 16. American recognition was extended without delay, Panama not being included in the Latin-American treaty barring recognition to governments established by revolution.

Aside from the familiar motives of hard times and foreign example, the upset in Panama appears to have been due chiefly to a demand for electoral reform, the choice of president being in the hands of a national assembly usually controlled by the government in power. This is the first disturbance in the canal region since the revolution which created Panama in 1903.

CONFERENCE IN NICARAGUA.—Following continued attacks on American marines in Nicaragua, and criticism in the Senate of the American policy of supervision, Secretary of State Stimson called a conference at Washington on January 29, to which were summoned Matthew E. Hanna, our minister in Nicaragua, Colonel Douglas McDougall, commander of the Nicaragua National Guard, General Frank R. McCoy, who was in charge of the 1928 elections, and others specially concerned or informed in Nicaraguan affairs. Though Nicaragua's finances are in good shape, with a total debt of only about $4,500,00, the revenues at the present time have declined owing to the slump in the price of coffee and other exports, and a loan of $1,000,000 is sought for payment of the National Guard and expenditures on roads and public works. There is also the question to be considered whether the United States will continue its supervision of the country's elections.

To this question of American supervision of Nicaragua elections the Foreign Policy Association devotes its fortnightly bulletin of December 24, 1930. Five possible policies are considered: (1) A modified supervision which would put Nicaraguans in charge of the local election boards and leave Americans in charge only of the thirteen departmental boards; (2) a coalition gov-

ernment of Liberals and Conservatives, or, as an alternative, a president not aligned with either party; (3) a guarantee of stability to Nicaragua, regardless of the type of government; (4) increased control, such as that during the last fifteen years in Haiti, to lay a solid groundwork for future self-government; (5) absolute non-intervention, leaving the people entirely on their own responsibility, as the only means of real progress. The last course is apparently favored, on the ground that our canal rights are already adequately protected by the Treaty of 1914, and that prevention of European intervention or occupation could be taken care of by landing marines in emergencies, without indefinite occupation.

CAMPAIGN FOR BRITISH TRADE.—The start of the Prince of Wales and his younger brother, George, on their visit to South America for the primary purpose of promoting British trade and friendly relations, was made on January 16 when the two British princes flew to Paris as the first stage of their 18,000-mile tour. Subsequently they sailed from Santander, Spain, for South America via Bermuda. The Prince of Wales will open the British Empire Trade Exhibition at Buenos Aires on March 14.

In the decade 1917-27 sales of American goods in Argentina increased about 10 per cent. In 1929 British exports to Argentina amounted to about $110,000,000 and American exports to about $210,000,000. In 1930 exports from both countries suffered some decline in value.

In addition to these steps taken to secure South American trade, a delegation from the Federation of British Industries will visit Canada in March to develop coöperation with Canadian industries and promote trade within the empire.

LEAGUE AND WORLD COURT

ROOT PLEADS FOR WORLD COURT ENTRY.—Although the U. S. Senate Committee on Foreign Affairs had previously decided to postpone action on the revised World Court Protocol until the next regular session of Congress, arrangements were made for a special hearing on the question on January 2, at which the venerable Elihu Root, now eighty-six years old, pleaded for the child of his own brain, the so-called Root formula for meeting the Senate's reservations regarding advisory opinions of the court. For three hours Mr. Root presented strong arguments to show that the preliminary exchange of views provided for in the formula is only such a concession as may fairly be expected from this country, that there is only the remotest danger of the court's ever insisting on rendering an opinion contrary to American wishes, and that in such an event there is always the privilege of withdrawal "without imputation of unfriendliness."

PAN-EUROPE MEETING.—As arranged last September, the committee of inquiry into the possibilities of a European union met at Geneva on January 16. There were twenty-seven European countries represented, twenty-two of them either by premiers or foreign ministers. Little was accomplished save to bring out forcibly the tremendous economic need for coöperation, or at least an agreement against more intense rivalry, and on the other hand the almost insuperable political obstacles that prevent it. At the outset political thunderclouds appeared when Italy with the support of Germany insisted that the question of inviting Russia and Turkey to join should be taken up at once. This was subsequently considered in secret session.

As the best present contribution they could offer to economic improvement, all the delegates at the closing session on January 21 joined in a "solemn manifesto" that "as the foreign ministers and premiers of European states we are more resolutely determined than ever to use the machinery of the League of Nations to prevent any resort to violence." This manifesto was first proposed by Foreign Secretary Henderson of England and was submitted to the full committee by M. Briand. The committee then adjourned to meet again at the time of the May session of the League Council when three subcommittees will report on different aspects of the problem.

ARMS CONFERENCE DATE SET.—The most notable accomplishment of the January session of the League Council was the final fixing of the date, February 2, 1932, for the world conference on limitation of armaments. The meeting will be held at Geneva if it is shown that the accommodations are adequate. The question as to who shall be

chosen for president of the conference, and by whom, was deferred until the May session. Indications were that the choice would be assumed by the council, with prospects that the United States Government may consent to the naming of an American for the office. Senator Dwight L. Morrow and Ambassadors Dawes and Hugh Gibson have been mentioned, in preference to Dr. Benes of Czechoslovakia, whose choice at one time seemed assured. Meantime, in a note on January 14, the Soviet government has objected to any chairman from a country with which that government is not in normal diplomatic relations, and has expressed the view that the selection of a presiding officer should be left till the conference meets.

ACTION ON SILESIAN PROBLEM.—Taking notably vigorous action on the protests from Germany regarding Poland's treatment of the Germans in Upper Silesia, the League Council condemned the activities of certain Polish political organizations, called on the Polish government to break off all connection with these bodies, and demanded a report on the execution of these requirements at the May session. Poland is said to have given private assurances that the present governor of the province would be removed.

Before the end of the session on January 24 the council also took up the Liberian slavery report, as noted below, and adopted a resolution providing that the International Opium Conference on May 27 shall consider the extension of the opium convention to include all narcotic drugs, and consider freely all schemes for limitation of production and export.

LIBERIAN SLAVERY INVESTIGATION.—The report of the international committee on slavery and forced labor in Liberia, made public on January 10, drew general attention to evils which have long existed in the African republic and in which the vice-president and other prominent officials have taken a leading part. Though this state of affairs was well known, and conditions not greatly different probably exist in certain European colonies in Africa, the report led to a strong note from the United States government to Liberia, and subsequent action on the part of the League of Nations Council, under which the original investigation was made. The League Council considered a plan for a commission of supervision in Liberia to consist of representatives of the United States and the five chief league powers. If Liberia should consent to such supervision and request it, the United States has expressed willingness to take part. A financial loan, however, would be essential to any program of reforms.

Secretary Stimson's severe note to Liberia, dated December 3, characterized the report as a "shocking indictment" and pointed out: (1) that Liberia had consented to the investigation with extreme reluctance; (2) that nearly all of the high officials of the country, including the vice president, were found guilty; (3) that no plan of reforms had been made and the officials were still in office; (4) that witnesses before the commission had been intimidated and later persecuted.

President King and Vice President Yancy thereupon resigned, and subsequently, through its representative at the League Council, the government "accepted in principle" all the reforms proposed and agreed to adopt them "to the full extent of her resources." It was made clear, however, that financial aid would be needed, and that Liberia expected similar action in other parts of Africa under European control.

Mr. Charles E. Mitchell, wealthy Pittsburgh colored citizen sent as the new American minister to Liberia, sailed for his post on January 13 and was expected to arrive in the latter part of February. It was intimated that he would not present his credentials to the new Liberian government until progress toward reform had actually begun.

GREAT BRITAIN AND COMMONWEALTHS

LABOR GOVERNMENT STRENGTHENS HOLD.—The most severe test of the strength of the MacDonald government was met on January 25 when after three days of bitter debate in the House of Commons the trades disputes bill passed its second reading by a vote of 277 to 250 and was safely relegated to committee, from which it will probably emerge in such mangled shape that Premier MacDonald can safely drop it without loss of prestige among his more radical followers who have forced him to support it thus far. In the vote the Conservative

opposition was joined by eight Liberals led by Sir John Simon. One Liberal voted for the bill and the rest adhered to the decision of the party caucus to refrain from voting.

RESULTS OF INDIA CONFERENCE.—The India conference in London ended on January 19 in an atmosphere of increased good feeling, with prospects of a new constitution for India extending self-government far beyond the earlier British proposals, provided always that the Indian extremists can be persuaded to accept the new offers and cooperate in the final framing of the constitution. As outlined in the New York *Times* of January 20 the main points of policy enunciated by Premier MacDonald at the end of the conference were as follows:

1. Amnesty for India's 50,000 political prisoners if "civil order" is restored in India.
2. An invitation to the Indian extremists to participate in the negotiations still to come, before the new Indian government is established.
3. Establishment of full responsible self-government in India, with the Imperial British government reserving control of finance, foreign affairs, and defense.
4. Extension of the voting franchise in India and the lifting of restrictions based on religion and caste.
5. Establishment of a legislature of two houses modeled along the lines of the Congress of the United States.
6. Encouragement of Indians to settle their own communal problems.
7. Uninterrupted continuance of negotiations to settle the details of the new government.

In subsequent discussion in Parliament both Conservative and Liberal leaders committed their parties to the government pledges made at the conference. The only attack on the policy was made in a fiery speech by Winston Churchill, who called the conference "an unauthorized would-be constituent assembly which had indulged in an avalanche of hysterical talk," and thus by his stand in opposition to Baldwin read himself out of the inner council of his own party.

In reality the constitutional problem is now in the hands of India, and further steps toward completing the constitution will depend on the attitude of the Gandhi party. To gain the support of these extremists was the great task of the Indian delegates, nearly 100 in all, carrying home the new spirit of coöperation created in London and a new hope for India's future.

GANDHI RELEASED.—To give the members of the All-India Congress full liberty for discussion of the new proposals, and as a move of conciliation and good will, the Indian Viceroy Lord Irwin on January 25 issued orders releasing from prison Mahatma Gandhi and all members of the All-India Congress working committee. One of the first subsequent acts of the committee, however, was to call for general amnesty of political prisoners and to announce that the civil disobedience campaign would continue, on the ground that the campaign was directed not against the existing government but against evils not to be tolerated under any government—such as use of intoxicants, use of foreign cloth, and denial of the "natural right" of the poverty-stricken Indian people to make their own salt. This was perhaps to be expected, but if the Congress party ultimately rejects the present proposals, it will put itself in the awkward position of a body of professed pacifists which insists on using force to gain results which could be obtained in reasonable degree by peaceful means.

EUROPEAN POLITICS

FRENCH CHANGE OF MINISTRY.—The Theodore Steeg cabinet in France was overthrown not unexpectedly on January 22, soon after the reassembling of Parliament, and after only a little over five weeks in office. Its fall followed a heated debate in which the conduct of the ministry of agriculture in regulating wheat prices was connected with speculations in wheat on the stock market.

After some delay Pierre Laval, a center leader and regarded as a protegé of Briand, brought together another makeshift cabinet described as a Tardieu government without Tardieu, with prospects that in a Chamber almost equally divided it may be defeated at any moment by a slight shift of support. At its first test on January 30, however, the new ministry gained the surprisingly large majority of fifty-four votes. It is considered certain that dissolution and new elections must come in brief time, and the present cabinet will be lucky if it carries on until the selection of a successor to President Doumergue, whose term ends on May 13.

FRANCE AND ITALY END NAVAL TRUCE.—Announcement was made from Paris on

January 20 that the naval truce between France and Italy was definitely ended and each nation free to engage in new construction as suits their needs. Italy, it is said, is going ahead with her suspended 1930 program. The truce was agreed upon after the London naval conference in the hope that the two countries might reach a general naval understanding, but it expired at the end of December and was not renewed.

SPANISH AIRMEN DISCIPLINED.—For the part taken by the Spanish air force in the recent rebellion, the Spanish government in January disbanded it as an independent organization and decreed that it should subsequently be combined with the Army. At the same time an order was issued increasing Army officers' pay from 10 to 25 per cent.

STRENGTH OF HITLERITES IN REICHSTAG.—In Germany, as in France, the government is now being carried on by a minority cabinet of the center, dependent always, in the case of Germany, on the support or at least benevolent neutrality of the Socialist (Social Democratic) party, which is the largest in the Reichstag with 143 votes. The National Socialist or Hitlerite party is second with a total of 107 votes, and can count on the coöperation of the Peoples' party of forty-one votes and the support if not coöperation of the Communists with seventy-six votes, making a combined opposition of 224 out of the total Reichstag membership of 526. As the party of youth, and the party that has promised most, the Hitlerites have drawn the allegiance of younger Germany and of all those who have lost faith in the ability of the older parties to save Germany from her present ills.

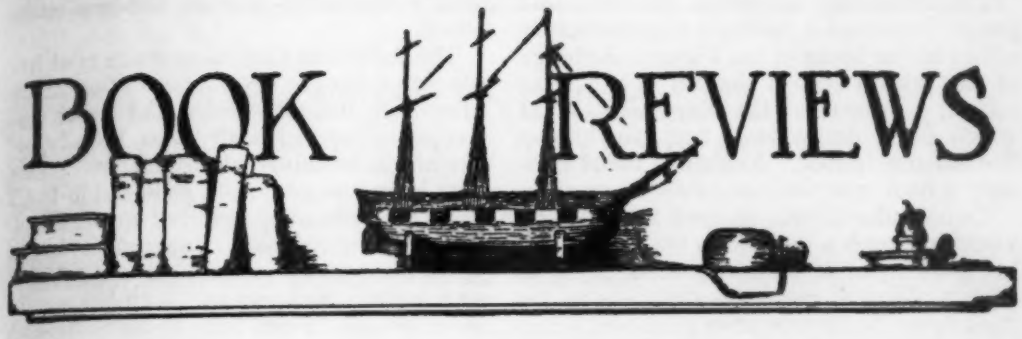
MANCHURIAN DICTATOR AT PEIPING.—Out of the visit of the Manchurian dictator Chang Hsuch-liang to Nanking and his conferences there with President Chiang Kai-shek came the surprising news that Chang had been delegated by Nanking to exercise personal control over the northern provinces, with headquarters at Peiping and retention of his army of nearly 150,000 Manchurians in the territory south of the great wall. Chiang's alliance with Nanking may not last long, but if he can keep his generals in Manchuria from running away with his home territory, he will enjoy in his present status a considerable extension of power.

COMMUNISM IN CHINA.—The *International Digest*, a new monthly review which prints abridgments of authoritative articles of international interest which appear throughout the world, has in its November (1930) number an interesting article from the *China Weekly Review* entitled "Moscow's Interest in the Chinese Communists." From the article it appears that at least a small sprinkling of the banditry in China are familiar with communist ideas and in touch with Moscow. The article in the *Review* queries how Soviet interference in China's affairs is on a higher plane than the "meddling" of the capitalist powers, as follows:

> Moscow, while openly lending moral and material support to her Chinese communist allies who are setting up Soviet administrations in China under the sickle and hammer banner of Red Russia, nevertheless offers strenuous objection to what Moscow terms "foreign imperialist intervention in China." One is therefore prompted to ask the question, "When is intervention not intervention?" When Moscow lends moral and financial support to Chinese communist armies and bandit gangs which loot cities, destroy foreign property, capture and hold foreigners for ransom, this apparently does not constitute "intervention" in the Russian definition of the word, but when foreign gunboats retaliate after they are fired upon by the same Russian-inspired and supported Chinese communists, that apparently constitutes "imperialist-intervention" in the opinion of Moscow's leaders. In other words, the Soviet government, which is using all the resources at its command to overturn the Chinese National government and establish a Soviet régime in China that would be tributory to Moscow, nevertheless cries to high heaven when the United States and the other powers attempt to protect their nationals and property interests against the depredations of Red Russia's allies in China!

In the number of the *International Digest* from which the extract above is taken there are twenty-five abridged articles from newspapers and magazines of Japan, China, Canada, and South America as well as European countries. It thus affords a most valuable supply of material—indispensable to the student of international affairs. The Institute PROCEEDINGS takes pleasure in welcoming this newcomer, especially since, to all appearances, it is not subsidized for the propagating of any particular gospel to the world.

BOOK REVIEWS



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H. M. S. EXCELLENT, 1830-1930. Edited by R. D. Oliver. Charpentier, Ltd., Portsmouth, England.

REVIEWED BY INSTRUCTOR RICHARD S. WEST, JR., U. S. NAVAL ACADEMY

One of the most interesting recent books on naval subjects is *H. M. S. Excellent, 1830-1930,* edited by R. D. Oliver. This is a compilation of records dealing with the history of Britain's unique school in naval gunnery located at Whale Island, Portsmouth. The school recently celebrated its one hundredth anniversary by a great "naval tattoo," which was the occasion for a festive gathering of gunnery officers of past and present and for the edification of the general public in a series of pageants depicting the progress of naval gunnery from early days down to the present.

In the days of Nelson the naval gun was the old smooth bore firing solid shot. Operating at close range against wooden hulls, this gun was sufficiently effective. It was not a complicated weapon. Owing to the transient personnel aboard ships in those days, it behooved a naval officer like Nelson to disparage any advance in gunnery methods which would make technical knowledge essential to gunners. Consequently, Nelson's ship captains placed their ships close alongside the enemy; his gunners poured shot with all speed into the nearby target, often double-shooting their cannon, attempting by the sheer impetuousness of their assault to exhaust the opposing force.

Then came the War of 1812 in which American captains employing a little science in gunnery scored brilliant victories over His Majesty's frigates *Guerriere, Macedonian,* and *Java.* The situation alarmed the Admiralty, and ships were ordered to sail in pairs. Captain Philip B. V. Broke of H.M.S. *Shannon* was the first to give a correct diagnosis of the situation. He trained the men behind his guns. At his own expense he fitted out dispart sights and quadrants for every gun on his ship, cut out arcs of circles on the deck behind each gun with degrees notched in so that his entire broadside could concentrate accurately on a target. As a result, on June 1, 1813, when the U.S.S. *Chesapeake* sailed out of Boston harbor the canny Britisher was more than prepared to wrest his victory from the gallant James Lawrence.

In the wardrooms there was now some talk of England's need of a gunnery school. Captain Sir John Pechell, an officer who had served on the West Indian station during the war, sent a proposal to the Admiralty, but nothing came of it. Fifteen years elapsed. Then a Commander George Smith in 1830 submitted a prospectus for a gunnery school aboard a ship to be "supplied with a gun and a carriage of each description now in use in the Navy, with different kinds of sights and every invention relating to gunnery thought worth a trial . . . a cabin to be supplied with books, drawings, models, etc., as a study for the officers of the ships in port, and any of the Navy on half pay who might, on application to the Port Admiral, be allowed access to the establishment."

The Admiralty approved his plan and placed Commander Smith, a supernumerary officer on the books of the *Victory*, in charge of the project aboard the old H.M.S. *Excellent*, a veteran of the Napoleonic Wars which for a dozen years had lain idle in Portsmouth harbor. England's naval gunnery school was now established.

Commander Smith warped the obsolete vessel into such a position in the harbor that her guns could be used in practice firing at targets placed at measured distances on the mud flats. Numerous other guns and pieces of equipment were also acquired and mounted aboard the *Excellent*.

In 1832 when Captain Thomas Hastings relieved Commander Smith, he found the work of the school already well begun. One of the new Captains' important duties was to test all varieties of ordnance and give an unbiased report to the Admiralty. A complement of 200 men was allowed the *Excellent* for this purpose. Many ship captains temporarily without a command flocked to the training ship, along with the younger officers and ordinary seamen who desired higher rating. All worked together on the same gun, mounting and dismounting it, learning the name and use of every part, loading the piece with shot and fake powder, practicing steadily. After they had become proficient in elementary maneuvers, they charged their cannon with real powder and blazed away at the targets. Using especially devised implements, "mud-larks" at low tide recovered the shot and sold them back to the *Excellent*.

Captain Henry Ducie Chads (second in command on the *Java* when that ship was overpowered by the *Constitution*) was one of the many commanders of the *Excellent* to introduce improvements in gunnery methods. He devised a "concussion" shell to offset the use by the French of a "percussion" shell, and introduced the principle by which cartridge and shot could be placed in the gun and rammed home together. Hitherto this had been strictly avoided.

In 1856 Whale Island, in Portsmouth harbor, was purchased by the Admiralty for a thousand pounds. It was a barren place containing some eleven and one-half acres. Before the end of the century this acreage had been enlarged to eighty by reclaiming the mud flats; and workshops, living quarters, recreational buildings, parade grounds, drill, and proving grounds had been established.

The American Civil War was a most fertile period for the development of ordnance, as well as for ship design and armor protection. The Admiralty was literally besieged by inventors, designers, and others with ingenious proposals, good and bad. All these the Admiralty referred to the *Excellent* for consideration. Experiments had to be made with ironclads, to see whether such vessels could operate with heavy guns in a seaway. Tests had to be made with bulkheads and armor plating. *The Scorpion* and the *Wyvern*, monitors built for the Confederacy, were taken over for experimental purposes. The *Royal Sovereign*, an old ship, had her superstructure cut down and four turrets placed aboard. Thus, for perhaps the first time, were the unique features of the C.S.S. *Merrimac* and the U.S.S. *Monitor* combined in a single vessel. Endless experimentation was also carried out with breech-loading mechanisms. Whale Island shops often produced their own mountings for breech-loaders. "These guns had no trunnions and had to be attached to the cradle by means of circumferential grooves and large hoop bands passed over and keyed in some way to the cradle, or carriage. The carriage recoiled on a pair of slide beams, the recoil being taken up by a recoil cylinder and piston."

In the later years of the century the gunnery school was commanded by many of England's most renowned naval officers. Captain John Arbuthnot Fisher, Britain's First Sea Lord during the World War was in command of the *Excellent* from 1883 to 1886. Among other improvements made under his régime was the application of electricity to ordnance. Captain Percy Moreton Scott, who commanded the *Excellent* from 1903 to 1905, did much to prepare the Royal Navy for the ordeal of the World War. He had excellent coöperation from above, since Fisher was then serving his first term as First Lord and Captain J. R. Jellicoe, was Director of Naval Ordnance.

In editing the records of the school's achievements, Mr. Oliver has included many details of no interest to one not sentimentally attached to Whale Island. However, the excess of intimate detail is not harmful, and the value of the whole far overweighs the irrelevance of some of the parts.

AVIATION AND THE NAVY BUILDING PROGRAM

By Rear Admiral W. A. Moffett, U. S. Navy

Editor's Note: Address delivered before the Women's Patriotic Conference on National Defense, Washington, D.C., January 30, 1931.

IT IS a great honor to address this distinguished gathering of women, meeting in Washington for their sixth annual convention to consider national defense.

No one appreciates more than the Navy the splendid and effective aid the organizations you represent have given in the past, and can be depended upon to give in the future, in spreading the doctrine of real patriotism, upholding the ideals of the nation, and in urging the necessity of actually doing something for adequate national defense.

The history of mankind reveals the dominant influence woman has always had on the spirit and progress of all nations. A man fights for some woman and not for his country alone. Some woman is his inspiration and her appreciation is his reward—what he strives and fights for. In battle, he thinks of her as Tennyson in his "Princess" sings:

> Thy voice is heard through rolling drums
> That beat to battle where he stands;
> Thy face across his fancy comes,
> And gives the battle to his hands.
> A moment while the trumpets blow
> He sees his brood about thy knee;
> And next like fire he meets the foe,
> And strikes him dead for thine and thee.

You come to Washington at an opportune time. We are all looking towards one particular goal, the passage of the Navy building program at this session of Congress, to enable us to make a start towards building the London treaty navy. Last year in London the United States came to an agreement with Great Britain and Japan on naval limitation, which demonstrated our friendship and desire to preserve peace throughout the world and also to insure us national security. There were, as you know, many different opinions on the results of that conference, but finally the London treaty was ratified by the Senate with clear and positive provisions for the United States Navy. If we build up to this treaty, we will have an effective and adequate navy for our needs. But such groups of Americans as you, must let it be known plainly that the people of this country insist on having such a navy or Congress may turn its attention to other issues. You have the right to speak, for you represent great groups of women in every state, organized and working in such a patriotic way that you encourage all who have the safety, welfare, and self-respect of our country at heart.

In time of war it is you women who suffer most. You, therefore, are the logical ones to demand protection. Many of you would have been spared this suffering had this country been a real sea power in 1914. If we had had an adequate Army and Navy, commensurate with a population of 120,000,000, the responsible leaders in Germany would have considered us before going to war, instead of regarding us with contempt. We could have forbidden war by declaring that we would oppose them with a real force of ships, men, guns, and aircraft. We could have prevented the loss of millions of lives and the untold suffering that has followed. We are faced today with a similar situation. It has been said that armaments make for war. We can judge by our own history—by 1776, 1812, 1861, 1898, and 1917. At none of these periods were we armed and yet war was forced upon us. In 1776, French sea power made it possible for us to win; in 1812 French sea power and land power indirectly won for us; in 1861, had the United States possessed the naval and military power it should have had, the long struggle would have been quickly settled, which would have been to the advantage of both sides. As it was, naval power settled the war by blockading and

strangling the Confederacy. In 1898 had we had an adequate Navy, Spain would never have gone to war. Our own history then, shows that we can not remain at peace merely by failing to provide forces of defense.

Under the terms of the London treaty, the United States will continue to have 135,000 tons of aircraft carrier tonnage; the Japanese, 81,000; or a ratio of 5-3. Each of the nations can also place flying decks on 25 per cent of their light cruisers; namely, the United States and Great Britain, about 80,000 tons, and Japan, about 43,000. I hope that the coming building program will result in the authorization of the unutilized tonnage for aircraft carriers; namely 55,200 tons; and that we will take advantage of the placing of landing decks on 25 per cent of the cruiser tonnage. These vessels will be, I believe, the forerunners of the warship of the future; namely, vessels which will carry airplanes on landing decks for taking off and landing, as well as guns. An airplane is a long range gun used also as a scout, a torpedo plane, and an observation platform, and we are coming more and more to regard them in this light.

The Navy Department has recommended, the President has approved, a moderate program for the first year towards building the ships, including their aircraft, that will give us parity in naval power with Great Britain and 5-3 with Japan, provided we build up to the treaty allowance. The program includes 280 airplanes for the ships. Bills to carry out this modest program have been reported out favorably in both the House and the Senate by the naval affairs committees. Little interest is evidenced in them by the public or the newspapers, or at least, very little compared with the tremendous interest taken in the London conference and later in the debate in the Senate, and the same influences that opposed an adequate navy in 1914 are opposing the present program.

We all know that organized influence is at work, under cover of course, to defeat this program. I need not tell this group of the methods being used to obstruct and delay. The activities of those who do not or will not see the necessity for national defense as peace insurance as well as national safety are not always carried on in the open. They masquerade in many guises, such as urging other measures and bills so that nothing can nor will be done for national defense in this session if they can prevent it. These legislative measures that are urged obstructively before the naval building bill may be important, but nothing is more important than national defense and safety.

Even when we secure authorization from Congress for the program, if that is allowed to go through, only half of the battle will be won, and we must all work harder still to secure the necessary appropriations before we can start building the ships. If we do not secure this authorization and some appropriation from this Congress to start the naval building program this year, it will mean that no start will be made until another year—a year from July next. Congress will adjourn March 4 and there will be no regular session until next December. We will again next year face a similar situation to the present one. Even if the program is authorized by the next Congress and the money appropriated, no start could be made until after July 1, 1932. This will mean that none of the ships will be finished when the next Limitation of Naval Armaments Conference meets in 1935 as provided in the London Naval Treaty.

We were fortunate in having Great Britain agree to parity at London. Japan gained concessions above the 3-5 ratio because she had the actual ships in commission, more than parity in some categories, and more than 3-5 in others. The financial situation in Great Britain and Japan had much to do with an agreement at London, but similar conditions may not exist again nor in 1935. If we go to the next conference with a blueprint navy, we will be seriously handicapped and a situation may arise that will not only wreck all that has been gained but may cause serious international misunderstandings.

It is your duty and that of all patriotic citizens to do all that can be done to have this modest program passed at this session of Congress. You have a right to ask that it be passed. Before leaving Washington, I suggest you see your senators and representatives. Talk to your fellow-citizens at home, and explain the situation to them. Those of you who have suffered, as many of you have by the loss of dear ones because in 1914 the United States made her young men go forth to war unprepared and because this country had not recognized its duty to maintain its place as a real sea power, have

a right to demand that we never be found unprepared again.

We spent billions for the last war. We are apparently about to appropriate over three billions for the veterans' compensation act, all because we were not adequately prepared in 1913-1914, and yet we are refusing to appropriate a total of less than a billion dollars, spread over five to ten years, for a Navy that will insure our security and prevent the expenditure of billions of dollars if another war is permitted. We are the only first-class power that does not believe in having adequate protection. All the other great nations have it.

There seems to be an abiding belief that when war breaks out we can meet the situation. How soon some of us have forgotten the lessons we should have learned from the last war! I hope that everyone who believes that we can spring to defend our land overnight without adequate preparedness, is reading the stories General Pershing is writing for the newspapers. The result of our shameful unpreparedness in the World War is disclosed in every line of this splendid biography. Thousands of lives were sacrificed. To defend ourselves on the outbreak of a war we must have not only war materials but trained personnel. Training takes not months but years; therefore in times of peace we must have not only warships but trained men.

When this country insisted on parity with Great Britain and 5-3 with Japan, was it just a gesture or did we really mean it? Japan came to the London conference with not only 3-5, but as I said before, more than parity in some categories, and for this reason obtained more than 3-5 in these categories. We gained parity with Great Britain but gave in to Japan because she had *real* ships and not *paper* ships.

We are the richest and most powerful nation in the world potentially, but we are not actually so unless we have adequate force in ships, arms, aircraft, and trained personnel to back up any position we may take.

We in the Navy are all for wise economy. We ask no needless expenditure of money. We ask only what is necessary for adequate national defense. We of the Army and Navy know what is necessary for adequate defense—it is our business to know. We know what the country needs for training and experience in peace to be ready for war. We are aware of conditions abroad and at home, propaganda, bolshevism, and want only to be strong enough to maintain the self-respect and honor of the nation. We are for the Kellogg Pact and other attempts to insure peace by arbitration and peaceful means, but we know that the Kellogg Pact and other treaties, as was the case with the treaty with Belgium, are not worth the paper on which they are written unless backed by sufficient force.

No nation fell intentionally, each felt strong and secure. Each fell from disintegration within, luxury, unwillingness to make sacrifices for national defense, as we are doing today, expenditures for the luxuries of peace, and refusing to spend money for national defense. A nation that continues to live as we are doing will suffer again, as we did in the last war and are suffering now. Millions for luxuries and comparatively little for national defense!

In considering national defense, do not forget aviation. It is a new weapon, a new power. Sea power is a term we have long heard. We must now think in terms of air power as a part of sea power. Aviation depends in many ways on sea power. We know how to use the old arms, ships, guns, and torpedoes, but comparatively little about the uses of this new weapon that knows no natural obstacles and proceeds through the air—a human, intelligent projectile. So we should leave nothing undone to develop it so as to be ready to use it to the fullest extent when the emergency comes.

In connection with the naval building program, there is probably nothing that would help unemployment more than construction of the London treaty navy. Eighty per cent of the cost of men-of-war is pay of American labor. The building of a man-of-war involves all of the arts and industries of the country, and skilled as well as unskilled labor distributed over the entire country. There is no question that a program for the building of ships, distributed over a period of years, would have a most beneficial effect on the whole industrial situation.

Of the greatest importance also is to get a merchant marine and personnel inferior to none, parity, at least, in merchant marine. A merchant marine is a large part of sea power. A navy is only a part of it. As long as we have a merchant marine inferior to

any other nation we will not have parity in sea power. We can gain it by building merchant ships just as we build cruisers. Each merchant ship can be changed into an aircraft carrier. Thus aviation will make merchant ships potential men-of-war. They can, when converted into aircraft carriers, carry bombing planes having a range of 600 miles. Before the advent of aviation, merchant ships could only carry comparatively small guns having only a few miles radius. Aviation has enormously increased the relative value of a merchant marine, and in getting parity in navies we must realize that we have still a long way to go to have parity in sea power. Think this over and see that we get a merchant marine inferior to none. It will not only be a most powerful and essential factor of national defense but of enormous value and of far-reaching importance to our commerce and national prosperity in time of peace. It would assist greatly in solving farm, labor, and unemployment problems.

The enemies of national preparedness have but one course of action open to them. Through propaganda and through lobbying they will attempt to influence Congress into voting against any increase of arms of defense. For the success of their efforts we may fear the worst, for in times gone by they have delayed and blocked legislation to such degree that we have fallen pitifully behind in building up to the treaty limit.

It is less than a year ago that the newspapers were clamoring about the London treaty, calling to our delegates not to "sell out" to the other powers; to stand by their guns for an adequate Navy. This they did; they fought for and achieved parity. But what good does it do? I was for the treaty as long as I thought Congress would build up to it. If the people of this country fail to demand a London treaty navy, then we deserve the defeat, the suffering and the humiliation that will come in the next emergency. The government is but the voice of the people. If we are too indolent to carry out our duty in supplying national defense, then we should frankly accept our position as a second-rate power, for such we will be beyond a shadow of a doubt. One way lies prosperity, honor, peace and self-respect, with an adequate navy; in the other, ultimate suffering and disaster.

I am no visionary, far from it, for I believe that in a practical world one must be practical. Enthusiastic as I am for naval aviation, I am positive that aviation alone is a pitifully weak defense for this vast country. We must have a fleet capable of protecting our country, supported by a strong and efficient air force with and as a part of the Navy. The two, fleet and air force, are supplementary branches of the service and not separate.

To insist upon an adequate London treaty fleet is the personal duty of every one of us. We must combat the influences of those working against it; we must convince those who fear that armed forces point the way to another world war that they are wrong.

Nothing is more essential to the welfare, honor, and self-respect of this country than the creation, maintenance, and operation of an adequate Navy, including its aircraft, second to none, built to the strength allowed by the London treaty.

U.S.S. *GLOUCESTER*

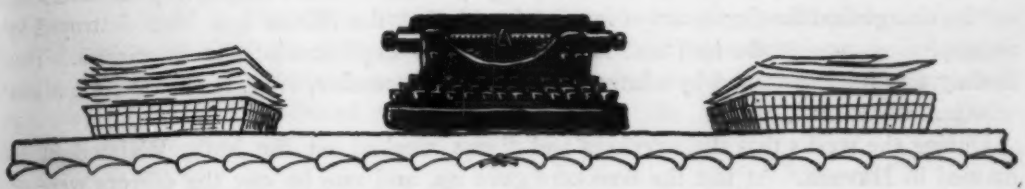
Courtesy Naval Records and Library, Navy Department

Courtesy Naval Records and Library, Navy Department

REAR ADMIRAL RICHARD WAINWRIGHT, U. S. NAVY

The thirteenth president of the U. S. Naval Institute, 1909-11.

SECRETARY'S NOTES



Rear Admiral Richard Wainwright, U. S. Navy

Rear Admiral Richard Wainwright, U. S. Navy, a great, great grandson of Benjamin Franklin, and son of Commander Richard Wainwright, U. S. Navy, was born in Washington, D.C., December 17, 1849. He had been a member of Tad Lincoln's White House gang, and this together with the recommendation of Admiral Farragut, whose flagship had been commanded by Wainwright's father, enabled him to get an appointment at large to the U. S. Naval Academy from President Lincoln in 1864.

After graduation in 1868 Wainwright experienced the usual young officer's details afloat and ashore. He was promoted to ensign in 1869, to master in 1870, and to Lieutenant in 1873. He saw service afloat as flag lieutenant to Rear Admiral T. H. Patterson, and as flag secretary to Rear Admiral J. E. Jouett. After a tour of shore duty in the Hydrographic Office he commanded the Coast Survey ship *Arago*.

On Wainwright's return from the Asiatic station he learned that a court of inquiry, of which Admiral Porter was president, had placed the blame for the wreck of the U.S.S. *Huron* at Hatteras upon the dead officers, some of whom were Wainwright's classmates. He made an intensive study of the records of the case, and owing to his varied experience in the Coast Survey and at the Hydrographic Office, he proved that the disaster was caused by erroneous data furnished by an expert in Washington. This method was customary at the time and the officers responsible for the navigation of the ship were constrained to accept the data furnished by the expert. On account of his new evidence, Wainwright was instrumental in having the court reconvened after a lapse of two years. The former findings were reversed, thus vindicating the dead officers.

His first connection with the U.S. Naval Institute occurred in 1888, when he was ordered to the Naval Academy where he was assigned as secretary of the Institute in addition to his other duties. He reorganized the office force and indoctrinated Mr. Conroy in his duties as clerk, making him the indispensable head of the Institute's permanent staff.

After a tour of sea duty as executive officer of the *Alert* (1890-1893), he returned again to duty in the Hydrographic Office. In 1894 Wainwright was promoted to the rank of lieutenant commander after serving twenty-one years as a lieutenant, a not uncommon experience in those days of stagnation. In 1896 he was ordered to duty in the Navy Department as chief intelligence officer, where he was thrown in intimate contact with Theodore Roosevelt, the Assistant Secretary of the Navy. A lasting friendship formed at this time was continued up to the time of the death of Mr. Roosevelt.

In 1897 Lieutenant Commander Wainwright was ordered as executive officer of the *Maine*. Immediately after the destruction of that vessel he took charge of the rescue of the survivors who were struggling in the water or entangled in the wreckage. Wainwright was one of those who firmly believed that the *Maine* had been destroyed by an ex-

plosion outside the hull and no one was more impatient than he to establish this fact. He was assigned quarters on the tender *Fern* and charged with the duty of recovering the bodies of the victims as well as with examination of the hull of the vessel for evidence of the source of the explosion. It was due largely to the evidence adduced by the divers under his charge that the first court of inquiry found that the *Maine* had been destroyed by an explosion outside the hull and not an accidental explosion of the magazines. This finding was fully sustained by a later board held in December, 1911, at the time the *Maine* was unwatered in Havana.

During the weeks that the wreckers and divers worked on the hulk, Wainwright remained in Havana. At last the wreckers gave up, and one by one the officers were ordered to Washington. It was known then that war with Spain was inevitable. On the day that the last wrecker was ordered home, Admiral Manterola, the Spanish naval commander in Havana, ordered his men to haul down the United States ensign hoisted on the mainmast of the wrecked ship. Hearing of the order, Wainwright sent word to the Spanish authorities that he would resist with force, if necessary, the lowering of the colors. Upon his departure from Havana later he himself hauled down the colors.

When war was declared with Spain, Wainwright applied for command of the converted yacht *Corsair,* renamed the *Gloucester.* This vessel was placed in commission on May 16, 1898, fitted out at the Quintard Iron Works in Brooklyn, and sailed for Key West on May 26. On arrival at Key West, Wainwright found a number of ships clamoring for coal and seeking an opportunity to join Sampson off Santiago. By dint of surreptitious coaling from barges and schooners assigned to other vessels he was ready on June 4 when the opportunity offered of transporting Colonel Hernandez of the Cuban Army to Banes. This duty completed, the *Gloucester* proceeded to the blockade off Santiago where Wainwright reported to Admiral Sampson on June 8.

On the morning of July 3, when the Spanish ships stood out of the harbor, the *Gloucester* was in position 3,000 yards southeast of the Morro. Fire was opened on the enemy cruisers as they steamed to the westward but the *Gloucester* slowed down waiting for the torpedo boats *Pluton* and *Furor* which were following. Misreading a signal from the *Indiana* to mean "Gunboats will advance" Wainwright closed in on the two torpedo boats and succeeded in sinking the *Furor* and driving the *Pluton* on the rocks. After the action was over the *Gloucester* stood in close to the burning *Maria Theresa* to see what assistance could be rendered. Seeing some men on the beach clad in underclothes, Wainwright sent in a boat which returned with Admiral Cervera and some of his staff. They were treated with the greatest courtesy, fitted out with clothes and then transferred to the U.S.S. *Iowa.* For his valor during the battle Wainwright was advanced ten numbers in rank and was later presented a sword and silver service by the citizens of his native city, Washington, D.C.

Upon his detachment from the *Gloucester,* Wainwright was ordered to the U.S. Naval Academy as officer in charge of ships. In 1900 he was made superintendent of the U.S. Naval Academy, which entailed the added task of pushing forward the work on the new academy. Detached from this duty in 1902 he commanded the U.S.S. *Newark* on the South Atlantic station after which he served ashore as a member of the general board. In 1907 Captain Wainwright was ordered as senior member of a board to make recommendations regarding the course of study at the Naval Academy. It was largely due to the recommendations of this board that the study of electrical engineering was given a broader scope.

During the cruise of the Atlantic Fleet around the world, Captain Wainwright commanded the *Louisiana,* and in May, 1908, was given command of the Second Division. He was commissioned a rear admiral on July 11, 1908, flying his flag on the *Georgia.* On December 3, 1909, he was appointed by Secretary G. von L. Meyer as his aide for operations. After two years at this important post he retired for age on December 17, 1911. During his tour of duty as aide for operations, Admiral Wainwright was elected president of the U.S. Naval Institute, an organization in which he was always intensely interested and to which he contributed many valuable essays. He died in Washington, D.C., March 6, 1926.

Sailing Boats for Fleet Use

An officer interested in sailing has been kind enough to furnish us with the pictures of new sailing rigs for Navy dinghies, shown on pages 387 and 388. His letter, which in part follows, may appeal to many who are interested in seeing a real sailing boat carried on board.

I am forwarding two photographs of a new experimental eighteen-foot sailing dinghy, four of which were recently designed and constructed by the Navy Yard, Portsmouth, New Hampshire. Two jib-headed and two gaff-headed rigs were built. The former have already been issued to the *Arizona* and the *Pensacola,* and one of the latter to the *Salt Lake City.* The fourth boat is as yet unassigned.

Those of us who have had the pleasure of building this boat are very anxious that she be appreciated by the service and that the general scheme of redesigning our pulling and sailing boats in keeping with modern yacht practice, in as far as it is practical to so design Navy boats, be encouraged.

There is now at the Bureau of Construction and Repair the detail plan of the yawl rigged, centerboard, jib-headed twenty-six foot whaleboat, which was designed to replace the present standard rowing whaler. The bureau, however, thought best that the sailing dinghy be first tried in service. This design is only tentative, and it has not yet been accepted nor has it been sanctioned by the Bureau of Construction and Repair.

The details of these new rigs, with their light Egyptian sail cloth, hollow spars, yacht blocks, and sail tracks enable these boats to be quickly rigged and unrigged alongside, and, by saving in top weights, allow more sail to be carried. It seems probable that, if this boat is adopted, a smaller rudder will be provided for the boat under oars, and a heavy jury rig for emergency abandon ship.

These boats have been designed in the belief that there exists in the Navy a real desire for small-boat sailing, a desire that would seem only natural to those who elect to follow the sea as a calling. Sailing and pulling in fine boats might be to us what polo is to the Army, a gentleman's sport germane to our profession. The present Navy boats are awkward under oars and sail. Improved boats can be designed which will be really smart pulling and sailing boats, while retaining at the same time the essential life boat and abandon ship features of the present designs.

The plans for the new whaler and the building of the four experimental dinghies are only a beginning. It is hoped that as interest is aroused and funds for boat replacements become available, boats of new and improved design, in place of the boats now standard, may be built.

PUBLICATIONS

U. S. NAVAL INSTITUTE, ANNAPOLIS, MARYLAND

By a decision of the Board of Control, all members are allowed a discount of 10% on books published by the Naval Institute and 5% on those of other publishers (government publications excepted).

AVIATION

Aircraft Construction.
Prepared under the direction of Lieutenant Commander F. P. Thomas, U. S. Navy. This book presents aircraft in its general features together with elements requisite to a fundamental understanding of the subject. 1929. 232 pages. $3.00.

Naval Aviation. Revised edition. New illustrations. 1929. 140 pages. $1.75 postpaid.

Airplanes, Airships, and Aircraft Engines.
By Lieut. Albert Tucker (CC), U. S. Navy. 1921. 436 pages. $3.50 postpaid.

ENGINEERING

Naval Auxiliary Machinery.
Compiled by officers of the Department of Engineering and Aeronautics at the Naval Academy, this book covers auxiliaries used in the naval service. 1929. 152 pages; 11 folders; many illustrations. $3.50 postpaid.

Principals of the Basic Mechanisms.
By Lieut. Comdr. R. N. S. Baker (CC), U. S. Navy, and Associate Professor W. E. Farrell, U.S.N.A. 1926. 135 pages. $3.75 postpaid.

Engineering Materials and Processes.
Is the successor of Danforth's *Mechanical Processes.* By Lieut. Comdrs. G. B. Ashe and J. I. Hale (CC), U. S. Navy. Reprinted 1930 with slight changes and corrections. 267 pages. $2.50 postpaid.

Internal Combustion Engines.
By the Department of Engineering and Aeronautics, Naval Academy. Fourth edition. 1931. 300 pages. $4.25 postpaid.

Naval Reciprocating Engines.
Compiled by Lieut. Comdr. L. P. Bischoff, U. S. Navy. Some material has been taken from *Naval Reciprocating Engines and Auxiliary Machinery,* by Barton and Stickney, and new material added. 1929. 208 pages; many illustrations. $2.50 postpaid.

Marine and Naval Boilers.
Compiled by officers of the Department of Engineering and Aeronautics, Naval Academy, this text has been completely rewritten with the exception of Chapters VI and X. 1929. 194 pages; 16 folders; many illustrations and diagrams. $3.00 postpaid.

Naval Turbines.
By Commanders O. L. Cox and M. A. Libbey, U. S. Navy. 1924. 241 pages with many illustrations and drawings. $5.00 postpaid.

Storage Battery Manual.
By Lieutenant Commander L. C. Dunn, U. S. Navy. 1920. 400 pages. $5.00.

LANGUAGES

French Nautical Phrase Book and Reader.
By Professor P. J. des Garennes, U.S.N.A. 1921. 181 pages. $1.50 postpaid.

A Spanish Nautical Phrase Book and Reader.
By Professor Arturo Fernandez, U.S.N.A. 1925. 175 pages. $2.00 postpaid.

Writing and Speaking: a Handbook for Naval Officers.
By Professor Carroll S. Alden, U.S.N.A. (This book replaces *Composition for Naval Officers.*) 1927. 359 pages. $2.50 postpaid.

LAW

International Law for Naval Officers.
By Comdr. C. C. Soule, U. S. Navy, and Lieut. Comdr. C. McCauley, U. S. Navy. 245 pages. Revised 1928 by Lieut. Comdr. C. J. Bright, U. S. Navy. $2.00 postpaid.

Constitutional Law.
Reprinted 1924. By H. J. Fenton, M.A., LL.D. 351 pages. $2.25 postpaid.